Using implementation intentions to reduce drivers' speeding behaviour

by

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‘This thesis is the result of the author’s original research. It has been composed by the author and has not been previously submitted for examination which has led to the award of a degree.’

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Abstract

Implementation intentions are IF-THEN plans that facilitate the performance of intended behaviours by linking critical situations in which to behave with goal-directed responses, or strategies, that ensure successful behavioural performance. This research investigated the effect of implementation intentions on drivers' speeding behaviour. Chapter 1 discusses the negative impact of speeding on road safety, the economy, the environment and health and wellbeing. Chapter 2 explores the influence of motivation (e.g., goal intentions) and habit on speeding behaviour and concludes that a substantial proportion of drivers speed despite holding generally positive intentions to avoid speeding. Chapter 3 introduces the concept of implementation intentions and reviews research suggesting that they could be useful for reducing speeding.

Chapter 4 presents study 1, in which the effect of implementation intentions on self-reported speeding was tested while addressing several limitations with the existing evidence-base. Implementation intentions were effective at reducing speeding and moderated the past-subsequent behaviour and goal intention-subsequent behaviour relationships, in line with the idea that implementation intentions can weaken habits, thereby allowing drivers to behave in accordance with their goal intentions.

Chapter 5 presents study 2, in which a driving simulator was used to test the effect of implementation intentions' on objectively measured behaviour and to test the extent to which the effects of implementation intentions generalise from the situations

specified in the IF component of the plan, to unspecified situations. Behaviour-change occurred in specified situations and, also, contextually similar unspecified situations.

Chapter 6 presents study 3, which focused on the THEN component of implementation intentions. The most effective type of goal-directed response for reducing speeding was explored. No effect of implementation intentions was observed. Potential reasons are discussed.

Chapter 7 presents the implications for road safety and future research.

Chapter 1: Speeding: The Applied Context

1.1 Introduction

This chapter provides the applied context for the research presented in this thesis. More specifically, it will discuss the effect of exceeding the speed limit on road safety, the economy, the environment and health and well-being with a view to demonstrating the need for effective interventions (i.e., interventions that reduce the performance of this aberrant behaviour). The prevalence of speeding will also be addressed. Finally, interventions that are currently used to reduce speeding (i.e., police enforcement, road and vehicle engineering and road safety education) will be reviewed in order to consider the extent to which they are fit for purpose.

1.2 The effect of speeding on road safety

Road safety is an issue of national and international importance. World Health Organisation (WHO) data show that traffic crashes are a global problem with around 1.2 million people dying as a result of road traffic crashes each year (WHO, 2015). In addition, between 20 and 50 million people are estimated to be injured or disabled around the world every year as a result of traffic crashes (WHO, 2004). Also, deaths caused by road traffic crashes are predicted to rise to 1.9 million by 2020 if no remedial action is taken (WHO, 2015). In Great Britain, the total number of road traffic crashes annually, including those not reported to the police, is between 630 and 800 thousand (Department for Transport, 2014a). Although road deaths have decreased by 2% and serious injuries by 6% since 2012 (see figure 1.1), these reductions are relatively modest. Furthermore, traffic crashes still represent a

problem that requires attention as 138,660 personal injury road accidents were reported to the police in 2013, resulting in 183,670 casualties (1,713 deaths and 21,657 serious injuries; Department for Transport, 2014a; see figure 1.1). It is unsurprising therefore that the UK Government has national targets to reduce road deaths and serious injuries by at least 33% by 2020 compared to the average number of road deaths from 2004 to 2008 (Department for Transport, 2009). The Scottish Government also has a target to reduce road deaths by 40% and serious injuries by 55% by 2020 (The Scottish Government, 2009).

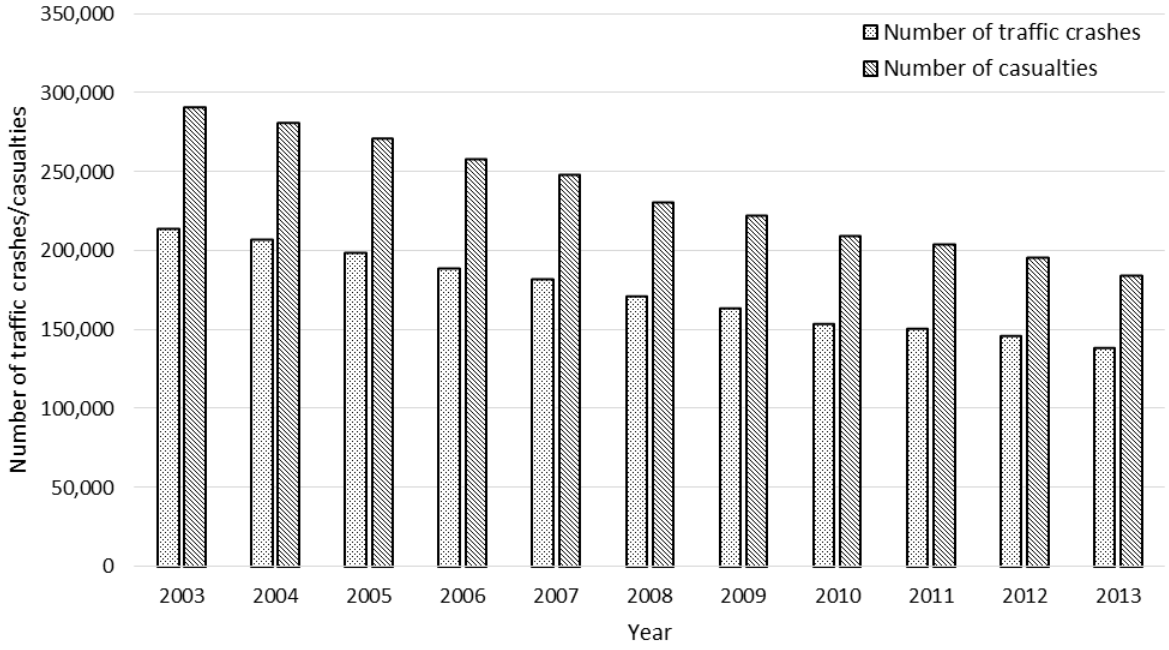

Figure 1.1. Reported road traffic crashes and casualties in Great Britain from 2003-2013

Traffic crashes are also a problem on all road types in Great Britain, particularly roads in built-up, urban areas. In 2013, there were 186,099 reported traffic accidents

of all severities on built-up roads, 54,897 on non-built-up roads, and 11,917 on motorways (Department for Transport, 2014b; see figure 1.2). In line with these statistics, it is estimated that two-thirds of all reported accidents occur on built-up roads with a 30 mph speed limit. For example, 71% of traffic casualties occur on built-up roads compared with 24% on non-built-up roads and 5% on motorways (Keep & Rutherford, 2013). Reductions in traffic crashes and casualties are therefore needed on all types of road. However, it would seem that reducing crashes on roads in built-up areas, in particular 30mph roads, would have the biggest beneficial effect on the overall casualty rate and is therefore likely to help Governments reach their casualty reduction targets.

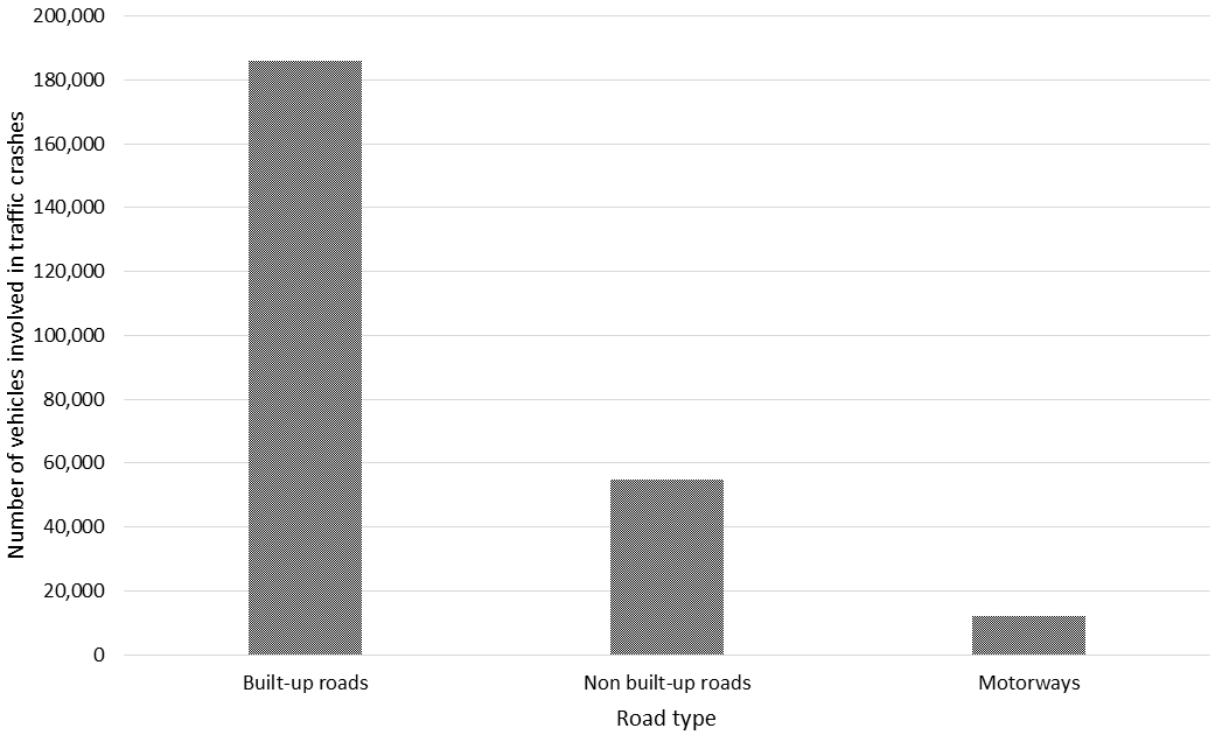

Figure 1.2. Vehicles involved in reported road traffic crashes on built-up roads, non built-up roads and motorways in Great Britain in 2013

Department for Transport statistics also show that a range of vehicles are involved in road traffic crashes every year (e.g., pedal cycles, motorcycles, cars and vans, buses/coaches, and heavy goods vehicles) but it is consistently found that the vast majority of vehicles involved in reported accidents of all severities are cars and vans. For example, in 2013, cars accounted for over half (n = 185,769) of all crash-involved vehicles (n = 252,913) in Great Britain (Department for Transport, 2014c; see figure 1.3). These statistics, of course, are likely to reflect the fact that cars make up the majority of vehicles on the road. Nonetheless it is clear that any substantial reduction in the overall crash rate is only likely to be achieved if traffic crashes involving car drivers can be reduced.

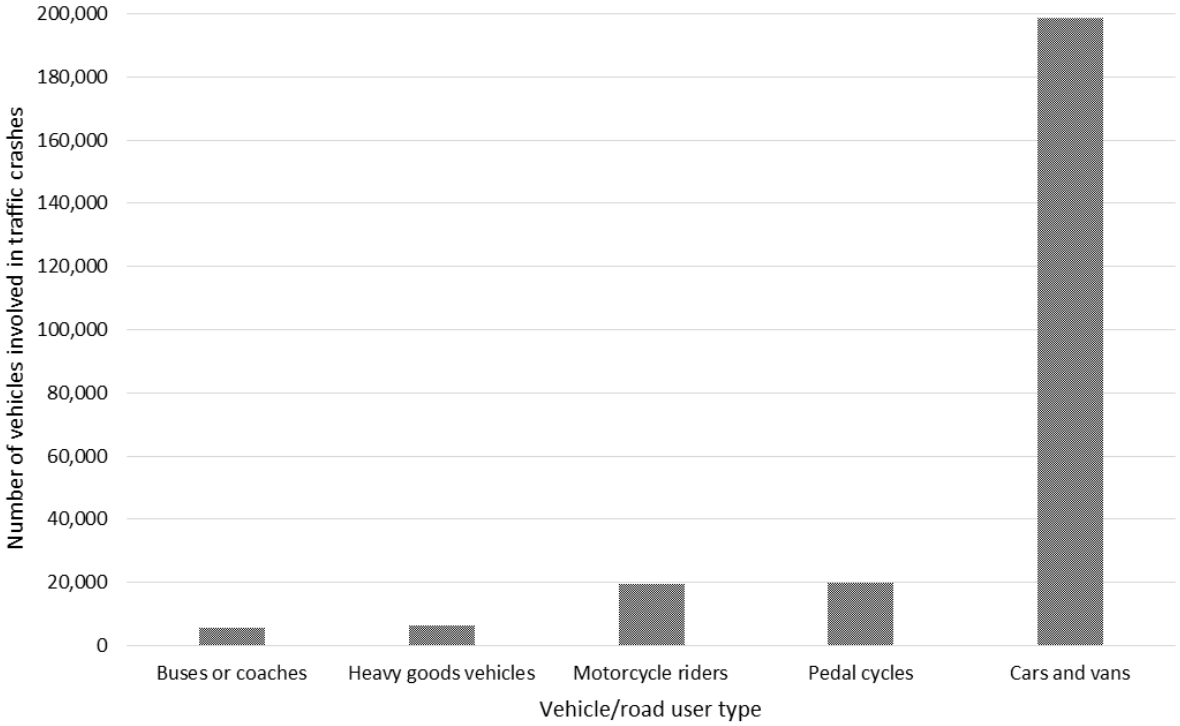

Figure 1.3. Type of vehicle involved in reported road traffic crashes in Great Britain in 2013

In order to better understand how traffic crashes and casualties can be reduced, an understanding of the causal determinants of traffic crashes is needed. Road safety research shows that there are many different causes of traffic crashes (e.g., Abdel-Aty, Ekram, Huang & Choi, 2011; McKnight & McKnight, 2003; Sharma, 2008). For example, factors that contribute towards traffic crashes can be poor road conditions (e.g., defective road surfaces), weather conditions (e.g., rain or fog), vehicle defects (e.g., defective tyres, brakes or indicators), or driver inexperience (e.g., being a newly qualified driver). However, aberrant human behaviour (e.g., injudicious actions such as exceeding the speed limit) is the biggest cause. In fact, studies have shown that around 90% of all traffic crashes could be attributed to road user behaviour characteristics (Bener & Crundall, 2004). This issue of aberrant driving behaviour and traffic crashes has therefore received substantial research attention. In particular, a seminal study by Reason, Manstead, Stradling, Baxter and Campbell (1990) developed a tripartite definition of aberrant driving. According to Reason et al. (1990) aberrant behaviour can be classified as either a slip or a lapse, a mistake or a violation. A slip is where the action (i.e., the driving behaviour that is performed) is not as intended (e.g., inadvertently attempting to drive away from traffic lights in third gear). A mistake is failing to execute planned actions as intended (e.g., getting into the wrong lane on approaching a junction or roundabout). A violation is a deliberate departure from an official or unofficial norm of what is deemed safe or acceptable road use (e.g., getting involved in unofficial ‘races’ with other drivers or speeding). Importantly, it has been found that driving violations are the strongest predictors of traffic crash involvement.

In one of the first studies to demonstrate that driving violations are strongly associated with traffic crashes, Parker, Reason, Manstead and Stradling (1995) asked participants (*N*=1656) to complete standard questionnaire measures of how often they committed a range of specific driving behaviours. Participants indicated how often they typically perform a series of driving violations, mistakes and slips/lapses using 6-point response scales (0 = never; 1 = hardly ever; 2 = occasionally; 3 = quite often; 4 = frequently; 5 = nearly all the time). Participants also completed measures of whether they had been crash involved over the last three years. Regression modelling showed that only driving violation scores predicted crash involvement (odds ratio [OR] = 0.89, $p < .001$). Scores on the measures of mistakes and slips/lapses did not predict crash involvement (ORs = 0.96 and 1.02, respectively, both *p*s = *ns*). Many studies over the last 20 years have replicated these findings in the UK and other countries across the world. While some of these studies have shown that driving mistakes can also be significant predictors of crash involvement, the evidence overwhelmingly demonstrates that driving violations are the bigger predictors (de Winter & Dodou, 2010; Rowe, Roman, McKenna, Barker & Poulter, 2015; Stradling, 1999; Sullman, Meadows & Pajo, 2002). Additionally there is strong evidence that speeding is the largest contributory factor to traffic crashes out of all driving violations.

Before considering the evidence for a link between speeding and road traffic crash involvement, it is important to note a distinction in the literature on driver behaviour between speeding and driving speed (Silcock, 1999). Speeding is whether or not a

vehicle is travelling faster than a pre-set legal limit, which has been deemed the safe or appropriate maximum speed for a section of road. Driving speed is the rate at which a vehicle is travelling and this speed can be inappropriate (i.e., unsafe) for the prevailing conditions, even if it is within the legal speed limit. The argument is that a vehicle can be travelling at an inappropriate (unsafe) driving speed even though it is within the legal speed limit. For example, a vehicle travelling at a speed of 65mph on a motorway may well be within the UK's legal speed limit of 70mph, and therefore not defined as speeding, but that speed may still be unsafe in very heavy traffic and poor weather conditions (e.g., fog). It is also possible for two drivers with very different absolute driving speeds to exceed the speed limit to the same extent. For example, two drivers could both exceed the speed limit for 100% of their journey along a 30mph road, but one driver could be travelling at 35mph and the other at 55mph. The argument here is that there are likely to be important differences between these drivers in terms of their safety because of the differences in the extremity of their driving speeds. It is unsurprising that the driver travelling at 55mph is more unsafe given that there is an increase in braking distance to avoid a crash when driving at a higher speed (Nilsson, 2004). Faster speeds equate to shorter braking distances and give drivers less time to avoid a collision in the event of an immediate hazard (e.g., a lead vehicle braking hard, a vehicle pulling out of a junction or a pedestrian cross the road into the drivers' path). The basic dynamics of an impact also means that faster travelling speeds equate to greater crash severity.

Despite the distinction in the literature between speeding and driving speed, however, the research evidence for a link with traffic crashes is conclusive. The

available evidence shows that traffic crash-risk increases with both absolute driving speeds and the extent to which drivers exceed legal speed limits. Research investigating the link between driving speeds and traffic crashes has shown that increases in average speed are associated with increases in the frequency of traffic crashes (Taylor, Lynam & Baruya, 2000). For example, it is estimated that on average, a 1mph increase in driving speed is associated with a 5% increase in the risk of a traffic crash (e.g., Finch, Kompfner, Lockwood & Maycock, 1994) and a 14% increase in traffic fatalities (e.g., Taylor, Baruya & Kennedy, 2002). Research investigating the link between speeding and traffic crashes has, similarly, shown that increases in the frequency with which drivers exceed legal speed limits are associated with increases in the frequency of traffic crashes. For example, it is established that a 1% increase in the proportion of drivers exceeding the speed limit by 15mph is associated with a 25% increase in the risk of being involved in a traffic crash (e.g., Taylor et al., 2000). Similarly, Stradling (1999) found that drivers who had been penalised for speeding were 50% more likely to have been involved in a traffic crash compared with drivers who had no speeding offences. Furthermore, speeding (including driving too fast for the conditions) contributes to a quarter of fatal traffic crashes in the UK (Department for Transport, 2010). Outside the UK, the estimates are even higher (Liu & Chen, 2009). Additionally, the official UK statistics show that speeding is a contributory factor in many more traffic crashes than are other driving violations such as tailgating, which contributes towards half as many crashes, and drink-driving, which contributes towards a third as many crashes (Department for Transport, 2013a).

Overall, traffic crashes represent a global and national problem accounting for many deaths and injuries. Even though they are a problem on all road types, they are most common on roads in urban areas. The majority of vehicles involved in traffic crashes are cars and vans, and therefore, a substantial reduction in the overall crash rate is only likely to be achieved if crashes involving car/van drivers can be reduced. Violations are strongly associated with traffic crashes, and speeding, out of all violations, is the largest contributory factor to traffic crashes. Speeding is, therefore, an important behaviour to target in road-safety interventions.

1.3 The effect of speeding on the economy

In addition to safety dis-benefits of speeding, there is the financial cost to consider. For example, the yearly cost to the UK economy of traffic crashes resulting in deaths or injuries is around £13 billion, and traffic crashes resulting in damage only, cost a further £5 billion (Clifford & Theobald, 2011). On average, the economic cost of a single fatal road traffic collision is almost £1.8 million and a serious injury road traffic collision exceeds £200,000 (Clifford & Theobald, 2011). These figures take into account medical costs, legal and court costs, emergency service costs, insurance administration costs, property damage and loss of income. Although figures are not available in the UK for the financial cost of speed-related traffic crashes specifically, the NHTSA's National Centre for Statistics and Analysis (2009) estimate that speed-related traffic crashes cost the US economy around $40.4 billion per year. Given that speeding increases the likelihood of road traffic crashes (see section 1.2), it is also likely to have a sizeable impact on the economies of the UK and other countries across the globe.

Additionally, despite recent political thinking that increasing traffic speeds (through an increase in the legal speed limit on motorways) may be valuable to the UK economy, leading to the faster transportation of goods and services (Department for Transport, 2011), research actually shows that fast moving traffic can, somewhat counter-intuitively, increase travelling times. In effect, the simple law of physics that Time = Distance/Speed (i.e., faster travelling speeds equate to shorter travelling times) does not apply in traffic. In traffic, travelling times are dictated by traffic flow (i.e., the total number of vehicles passing a given point per unit of time, expressed as vehicles per hour). Traffic flow is a function of both speed and 'flow capacity' (i.e., the maximum sustainable flow of traffic passing a given point in one hour). Speed, flow and flow capacity are related by a hyperbolic curve (see figure 1.4) which means that increases in traffic speeds lead to increased flow (i.e., shorter travelling times) up until flow capacity is reached. Once flow capacity is reached, however, faster speeds equate to decreased flow (i.e., longer travelling times). In support of this, Rees, Harbord, Dixon & Abou-Rahme (2005) report that faster travelling speeds can increase the risk of congestion due to increased braking and accelerating and reducing vehicle speeds helps alleviate the problem. Given that the road network in the UK is often at capacity (House of Commons Transport Committee, 2010), it is perhaps unsurprising that traffic congestion has a negative impact on the economy. For example, it is estimated that traffic congestion will cost the UK economy £22 billion by 2025 if no remedial action is taken (Eddington, 2006).

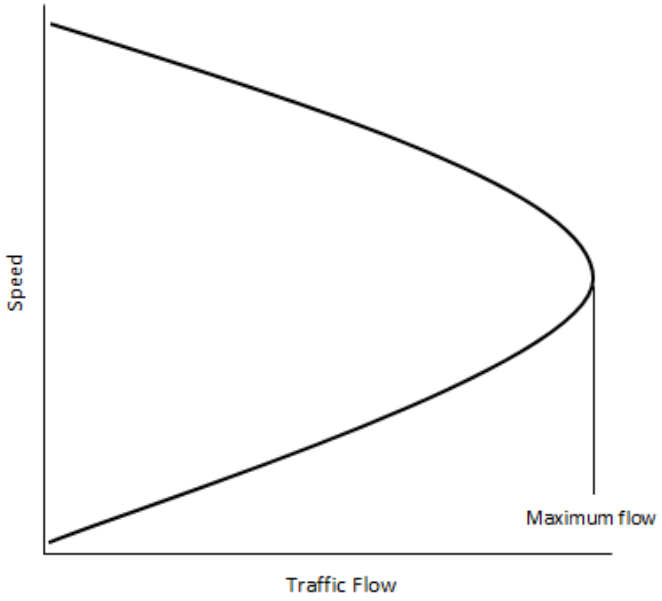

Figure 1.4. Hyperbolic curve showing the relationship between speed and traffic flow

In summary, it can be seen that speeding is an undesirable social behaviour because it increases the burden on the economy, partly by increasing the risk of road traffic crashes but also by increasing journey times on a road network that is typically running at capacity.

1.4 The effect of speeding on the environment

Not only does speeding impact on road safety and the economy, there are also environmental dis-benefits of this aberrant driving behaviour. The transport sector is a major contributor to global CO2 levels, with transport emissions accounting for approximately 23% of all global CO2 emissions, and land transport accounting for the largest share (16.5% of the global total; WHO, 2011). Road transport is additionally the biggest contributor of all greenhouse gases (i.e., CO2 *and* other

harmful emissions) in the transport sector (Bonnafous & Raux, 2003). Vehicles travelling at high speeds experience higher engine load requirements, and as a result, release more emissions (Barth & Boriboonsomsin, 2008). Speeding therefore contributes towards global air pollution.

Most governments across the globe have targets to reduce greenhouse gas emissions. In the UK the Government has set a target to reduce greenhouse gas emissions by 80% by 2050 (compared with 1990 levels; Department of Energy and Climate Change, 2011). Encouraging people out of their cars onto public transport (e.g., buses or trains) and more environmentally friendly transport modes (e.g., bicycles), in addition to improvements in vehicle engineering (e.g., electric cars), would clearly contribute towards achieving the Government's greenhouse gas reduction targets. However, there are also problems with these solutions. For example, bicycles are not always a feasible transport alternative to the car for many journeys (Tranter, 2010) and many groups of people such as older adults (e.g., Gilhooly, Hamilton, O'Neill, Gow, Webster, Pike & Bainbridge, 2002) and people with disabilities (e.g., Aldred & Woodcock, 2008). In addition, many individuals are unwilling to give up the convenience of their personal automobile (e.g., Stradling, Campbell, Allan, Gorell, Hill, Winter & Hope, 2003). Furthermore, the move towards new, more environmentally friendly transport technologies (e.g., electric vehicles) has been relatively slow (Moriaty & Honnery, 2004), with some authors arguing that they are viewed as expensive and unreliable (Chapman, 2007). Instead, there is a year-on-year increase in the use of bigger, environmentally inefficient private vehicles (Kim, Keoleian, Grande & Bean 2003; Sperling, 2003). Reducing transport pollutants

through modifications in driver behaviour (e.g., reductions in speeding) is therefore important in order to supplement other strategies for reducing the environmental dis-benefits of traffic (e.g., Cristea, Paran & Delhomme, 2012; Delhomme, Cristea & Paran, 2013; Lauper, Moser, Fischer, Matthies & Kaufmann-Hayoz, 2015).

1.5 The effect of speeding on health and wellbeing

Research has also shown that speeding has a detrimental effect on health and wellbeing. The research reviewed in section 1.4 is relevant in this respect because CO2 and other greenhouse gases contribute to the development of cardiovascular and respiratory diseases (WHO, 2011). Additionally, fear of danger from fast moving traffic is one of the reasons frequently given by many people (e.g., parents of young children, people with disabilities and older adults) for why they use the car instead of walking or cycling, which are healthy behaviours that reduce the risk of obesity, heart disease and stroke (e.g., Christie, Ward & Kimberlee, 2010; Tranter, 2010; Ward, 1999). It has also been suggested that people who find it difficult to cross roads with fast moving traffic can be prevented from accessing goods and services (e.g., food shops or health centres) and that this can directly affect their ability to form social support networks and cause them to become socially excluded from the community (Christie et al., 2010; Tranter, 2010; Ward, 1999). Speeding also causes concern for parents about dangers for their children, often resulting in parents restricting their child's independent mobility (Tranter & Pawson, 2001). Christie et al. (2010) report that parents in disadvantaged communities, in particular, think there should be stronger enforcement in relation to speeding.

In addition, transport noise pollution affects a large proportion of the population, and particularly those in urban areas. Fast moving traffic can create a large amount of engine and tyre noise, which can irritate and disturb sleep of those subjected to it (Ward, 1999). It has also been suggested that noise pollution from fast moving vehicles can affect individuals' mental health by raising stress levels and creating anxiety about traffic (Ward, 1999). It is clear, therefore, that speeding can negatively affect the quality of life that individuals and their families experience. Reducing high speed traffic would therefore help alleviate these problems in addition to helping achieve benefits for general health and wellbeing (Ohrstrom, 2004).

1.6 The prevalence of drivers' speeding behaviour

As discussed in the previous sub-sections, speeding is a detrimental behaviour that contributes towards reductions in road safety and negatively impacts on the economy, the environment and individuals' health and well-being. Despite this, it is clear that speeding is a highly prevalent behaviour. Self-report surveys have shown that many drivers openly admit to speeding. For example, the RAC annual motoring report (2014) shows that 42% of drivers admit to speeding on 30mph roads, 67% on motorways, 43% on country roads and 44% in 20mph zones. Similarly, studies have shown that speeding is not generally viewed as a 'real' crime (e.g., Corbett, 2001) and is perceived as less serious than other motoring offences (e.g., RAC, 2014; Stradling et al., 2003). Furthermore, a study by Walker, Murdoch, Bryant, Barnes and Johnson (2009) found that speeding is seen as a commonly performed and acceptable behaviour. For example, 40% of the sample reported that it was acceptable to exceed the speed limit by 10mph. In addition, almost all participants in

a study by Stradling et al. (2003) agreed that the majority of people drive at around 10mph above the posted speed limit.

These findings from self-report studies are also mirrored in objective data that make up official statistics on the proportion of vehicles exceeding the speed limit. The UK Department for Transport (2015), for example, annually publish objectively measured vehicle speeds on different road types in Great Britain. Vehicle speeds are measured unobtrusively in free-flow traffic conditions. In 2014, Department for Transport data showed that 46% of drivers in Great Britain exceeded the speed limit in free-flowing conditions on motorways, 37% exceeded the speed limit on dual-carriageways, 45% exceeded the speed limit on 30mph roads and 21% exceeded the speed limit on 40mph roads (Department for Transport, 2015). These estimates of the proportion of drivers exceeding the speed limit in Great Britain are typical of those estimates from the past 10 years (Department for Transport, 2005 to 2015), implying that new approaches to tackling this aberrant road user behaviour are needed.

Overall, research and official statistics show that speeding is a commonly performed driving violation across a range of road types. This is the conclusion regardless of whether speeding is directly observed or measured via self-reports.

1.7 Interventions to reduce speeding

Given that speeding has negative consequences for safety, the economy, the environment and health and wellbeing, and that it is highly prevalent, interventions to reduce the performance of this driving violation are commonplace. The three main

types of interventions used to reduce speeding are: enforcement (e.g., speed cameras and road-side policing); road and vehicle engineering (e.g., road humps, roundabouts and speed limiters); and education (e.g., media campaigns, and speed awareness courses). The effectiveness of these different types of interventions is considered in the following sub-sections.

1.7.1 Enforcement

Enforcement strategies aim to make people fearful that they will be caught and punished for speeding (e.g., if a speed camera or road-side police detect a speeding vehicle, the driver will be fined and receive penalty points on their license). Reviews of the effects of speed cameras and other enforcement methods (e.g., road-side policing) have shown that this intervention method can reduce road traffic crashes and related casualties. More specifically, reductions in collisions, injuries and deaths in the immediate vicinity of the speed camera sites have been found to range from 5% to 69%, 12% to 65% and 17% to 71%, respectively (Pilkington & Kinra, 2005). In addition, speed enforcement detection devices have also been shown to reduce speeding behaviour. A review by Wilson, Willis, Hendrikz and Bellamy (2009) examined 26 studies and found that all minus one study reported reductions in average speed as well as reductions in the proportion of vehicles exceeding the speed limit. However, while enforcement is an effective deterrent, limited resources for traffic policing often means that, in practice, speeding goes unpunished. For example, Stradling, et al. (2003) found that 38% of Scottish drivers had been ‘flashed’ by a speed camera in the 3 years prior to the study

but 79% of these drivers stated that they had not received a fine or any penalty points for the offence. Receiving no negative consequence following a speeding offence is thus unlikely to change behaviour (Stradling, 2005). Additionally, speeding returns back to pre-enforcement levels very quickly after the enforcement intervention (e.g., police presence) is removed (i.e., there is a limited time halo effect) and after drivers pass an enforcement site (i.e., there is a limited distance halo effect). Essentially, the desirable effects of enforcement on driver behaviour is largely limited to the times when those interventions are operating and they are largely limited to the locations on the road network where they operate (see Champness, Sheehan & Folkman, 2005; Elliott and Broughton, 2005).

1.7.2 Road and vehicle engineering

Road engineering aims to control drivers' speed through external constraints. While road engineering can reduce traffic speeds (Mountain, Hirst & Maher, 2005), its effects are limited to those locations where they operate, similar to enforcement (see Champness et al., 2005; Elliott and Broughton, 2005). For example, drivers often reduce speed for traffic calming measures such as road humps and roundabouts but then proceed to increase their speed again after passing them (e.g., Boulter, Hickman, Latham, Layfield, Davison & Whiteman, 2001). Vehicle engineering also involves constraining a driver's speed choice. In particular, speed limiters are in-car technologies that automatically restrict a vehicle's maximum speed to the speed limit, so that the driver is then unable to drive any faster (Almqvist, Hyden & Risser,

1991). However, speed limiters are not mandatory and only a small proportion of drivers are in favour of them. For example, the Lex Report on Motoring (1997) found that only 18% of a sample of 1200 drivers would agree to having a speed limiter installed in their car. Subsequent research has shown that even when people voluntarily accept a speed limiter in their vehicle, many are likely to reject them after the experience. For example, Varhelyi, Comte and Makinen (1998) report that 60% of their sample thought that driving with a speed limiter was more stressful and frustrating than driving without it and 45% thought that the speed limiter caused them to become impatient (also see Varhelyi & Makinen, 2001).

1.7.3 Education

Educational interventions aim to promote positive attitudes and intentions towards complying with the speed limit, usually by raising drivers' awareness of the risks associated with speeding (Gandolfi, 2009). This aim is consistent with the notion that speeding is a driving violation (see section 1.2) and therefore underpinned by 'poor' or misguided attitudes (e.g., 'it is not unsafe for me to speed') rather than poor driving skills or ability (e.g., Lawton, Parker, Manstead, Stradling, 1997; Reason et al., 1990; Stanton & Salmon, 2009). Educational interventions should, therefore, have a wider influence on driver behaviour than should the other forms of interventions described above because they are designed to motivate safe driving (e.g., the avoidance of speeding) rather than control it through non-ubiquitous environmental constraints. In principle, this means that drivers are likely to adopt

appropriate ('safe') driving speeds across more of the road network. Therefore, educational interventions have the potential to over-come the above cited limitations with enforcement and engineering.

However, the evidence for the effectiveness of educational interventions is not very convincing. Generally, educational interventions have been shown to have rather limited effects of attitudes, intentions and behaviour. For example, Hardeman, Johnston, Johnston, Bonetti, Wareham and Kinmonth (2002) conducted a meta-analysis of a total of 30 studies in which researchers had tested the effects of educational interventions on outcome measures of intentions to behave and subsequent behaviour. The studies covered a range of social behaviours. It was found that the educational interventions changed intentions in only half of the studies. In these studies, the educational interventions typically produced Cohen's *d*s of around $d = 0.20$. In the social sciences $d = 0.20$, $d = 0.50$ and $d = 0.80$ are regarded as small-, moderate- and large-sized effects, respectively (e.g., Cohen, 1988; 1992). The changes in intentions due to the educational interventions reviewed by Hardeman et al (2002) were therefore of a small magnitude only. Two thirds of the studies in Hardeman et al.'s (2002) meta-analysis reported that the educational intervention successfully changed subsequent behaviour. In these studies the educational interventions typically produced Cohen's *d*s between $d = 0.20$ and $d = 0.50$, meaning that small-to-moderate levels of behaviour-change were found.

Similarly, Elliott and Armitage (2007) reviewed 34 studies in which researchers had tested the effects of educational interventions on a range of social behaviours. They found that only around half of the interventions (n = 18) successfully changed intentions and less than half (n = 15) successfully changed behaviour. Elliott and Armitage (2007) also found that the effect size estimates of the successful interventions were typically around d = 0.20 and never exceeded d = 0.50. Therefore, the changes in both intentions and behaviour due to the educational interventions reviewed by Elliott and Armitage (2007) were typically small in magnitude. At best, the interventions produced moderate-sized changes in intentions and behaviour.

The rather modest effects of educational interventions that have been observed across studies of general social behaviour (Elliott & Armitage, 2007; Hardeman et al., 2002) have also been observed with regards to speeding specifically. For example, Parker, Stradling and Manstead (1996) developed a set of educational videos designed to increase the perceived risks associated with speeding and get drivers to consider that their passengers might disapprove of them speeding, that speeding is an easily avoided behaviour and that drivers who speed should feel regretful. Participants randomised to an experimental condition watched these videos whereas participants randomised to a control condition watched a video about safety in a non-driving context. All participants completed measures of their attitudes and intentions to speed. Following intervention, it was found that the experimental participants were more likely to feel regretful for speeding than

were the control participants (d = 0.81). However, the interventions were unsuccessful at increasing the perceived risks associated with speeding and they did not make drivers more likely to believe that their passengers would disapprove of speeding or that speeding could be easily avoided. Additionally, the videos did not have any significant effect on drivers' intentions to speed.

Elliott and Armitage (2009) also conducted a randomised controlled experiment to test the effects of an educational intervention designed to promote compliance with speed limits. The participants randomised to the experimental condition read educational messages contained within an eight-page booklet. These participants completed measures of their attitudes, intentions and self-reported speeding behaviour both prior to reading the booklet and one month later. The participants randomised to the control condition completed the measures of attitudes, intentions and self-reported speeding behaviour only. It was found that the intervention did not have any effect on drivers' attitudes or intentions to speed. The intervention was found to reduce speeding behaviour. However, the reduction was very small (d = 0.19).

Another educational intervention designed to reduce speeding behaviour, which has been formally tested in high ecological validity, real-world context, is the 'Foolspeed' campaign (Stead, Tagg, MacKintosh & Eadie, 2005). 'Foolspeed' was a mass media advertising campaign that was used to

target drivers' attitudes towards speeding and speeding behaviour in Scotland. It consisted of a series of television adverts. One advert was designed to make the driver perceive that speeding is a dangerous behaviour and does not save time. Another was designed to make drivers think that speeding is not socially acceptable and the final advert was designed to make the driver think that they are in control of their speeding behaviour. The campaign was found to produce a small-sized positive change in drivers' attitudes towards speeding over a 3 year period (d = -0.11). However, it was not found to generate any changes in drivers' intentions to speed or speeding behaviour.

Therefore, consistent with the findings from reviews of general social behaviour (e.g., Hardeman et al., 2002), it can be seen that educational interventions typically produce only small-sized changes in drivers' speeding attitudes, intentions and behaviour, or no change at all. This is the case in studies testing educational interventions that are delivered under experimentally controlled conditions (e.g., Elliott & Armitage, 2007; Parker et al., 1996) and in studies testing educational interventions that are delivered in the real world (e.g., Stead et al., 2005).

1.8 Conclusions

To conclude, it can be seen from the material reviewed in this chapter that speeding has a negative impact on road safety, the economy, the environment and individuals' health and well-being. Despite this, however, it is clear that speeding is a highly

prevalent behaviour. Interventions to reduce speeding are widespread and include enforcement, engineering and education. Enforcement and road engineering have been shown to be effective at reducing speeding but their effects on driver behaviour are mainly limited to the times or locations on the road network where they operate. In addition, vehicle engineering can reduce speeding behaviour but vehicle devices to constrain driving speeds (i.e., speed limiters) are not mandatory and research has shown that most drivers' are not in favour of them. Educational interventions have the potential to overcome the limitations with enforcement and engineering because they are designed to internally motivate safe driving (e.g., the avoidance of speeding) rather than control it through non-ubiquitous environmental constraints. However, educational interventions have typically been shown to produce only small-sized changes in drivers' attitudes, intentions and speeding behaviour, or no change at all. The question as to why educational interventions have been shown to have such limited effects on drivers' behaviour therefore needs to be considered. This issue will be discussed in the following chapter.

Chapter 2: Why do drivers speed?

2.1 Introduction

As discussed in the previous chapter, speeding is a highly prevalent, yet undesirable social behaviour that has costs for road safety, the economy, the environment and health and wellbeing. However, it is a behaviour that has proved difficult to change. In particular, educational interventions, which should, in theory, produce widespread reductions in speeding across the road network, have been shown to have limited effects on speeding behaviour. A possible reason why road safety education has been shown to have limited effects on drivers' speeding behaviour is that it relies on the proposition that motivating drivers to change their behaviour (e.g., through changes in attitudes and intentions) is sufficient to evoke behaviour-change and this may not be the case. This chapter will explore this issue. Motivational models of human behaviour and the empirical evidence for them will be reviewed in order to provide insights into why drivers' speed. In light of that evidence, the limitations of the motivational approach to changing behaviour that is inherent in road safety education, will then be discussed. More specifically, it will be argued that motivating drivers to avoid speeding is unlikely, on its own, to be sufficient for bringing about substantial reductions in speeding behaviour.

2.2 Motivation and behaviour

Motivation is an important concept in psychology. It has been the focus of psychological investigation for almost 100 years (e.g., La Piere, 1934; Thurstone, 1931). In contemporary psychology, motivation is given a special place in social

cognition models. These models provide frameworks for how various motivational constructs combine to determine behaviour. They are especially prominent in the domains of social and health psychology where researchers rely on them to predict and explain human behaviour (e.g., Conner & Norman, 2005; Rutter, 2002). Whilst there are numerous social cognition models in the literature (see Conner & Norman, 2005), the following review focuses on the theory of reasoned action (Fishbein & Ajzen, 1975), the theory of planned behaviour (Ajzen, 1985), protection motivation theory (Rogers, 1983) and the prototype willingness model (Gibbons & Gerrard, 1995). These models have not only been tested across a range of social behaviours but they have also received at least some empirical attention in the domain of driving and can therefore be used to help explain drivers' speeding behaviour.

2.2.1 The theory of reasoned action

The theory of reasoned action (Fishbein & Ajzen, 1975; see figure 2.1) is one of the major social cognition models in the literature. It has attracted considerable research attention from psychologists (Albarracin, Fishbein, Johnson & Muellerleile, 2001; Cooke & French, 2008; Sheppard, Hartwick and Warshaw, 1988). It posits that *attitudes* (individuals' global positive or negative evaluations of performing a behaviour; e.g., 'for me, driving faster than the speed limit is bad/good') and *subjective norms* (perceived social pressure to perform or not perform the behaviour; e.g., 'people important to me would/would not want me to drive faster than the speed limit') combine to predict people's *goal intentions* (overall summaries of people's motivation to behave; Ajzen, 1985). Goal intentions are therefore summations of

individuals' motivation to perform a behaviour and represent overall decisions to act (e.g., 'I want/do not want to drive faster than the speed limit'). According to the theory of reasoned action, goal intentions, once formed, go on to predict performance of the behaviour in question. Therefore, in the present context, drivers who evaluate exceeding the speed limit positively (attitude) and believe that people important to them would want them to speed (subjective norm) would be likely to form goal intentions to speed. Those goal intentions would then subsequently increase the likelihood of speeding behaviour.

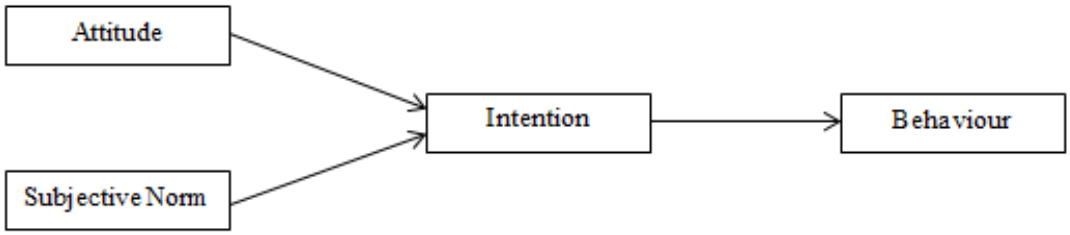

Figure 2.1. The Theory of Reasoned Action

Many meta-analyses provide support for the theory of reasoned action across numerous behavioural domains. A meta-analysis conducted by Sheppard et al. (1988) examined $k = 87$ separate studies of general social behaviour and found that the sample-weighted average correlation for the goal intention – behaviour relationship was $r_+ = 0.53$, and the sample-weighted average multiple correlation was $r+ = 0.66$ for the attitude + subjective norm – goal intention relationship. Similarly, a meta-analysis of $k = 33$ studies examining attendance at screening tests (Cooke & French, 2008) found that the sample-weighted average correlation for the goal intention – behaviour relationship

was $r+ = 0.42$. The sample-weighted average correlations for the attitude – goal intention and subjective norm – goal intention relationships were $r+ = 0.51$ and $r+ = 0.41$, respectively. In addition, a meta-analysis of $k = 96$ studies of condom use (Albarracin et al., 2001) found that the sample-weighted average correlation for the goal intention – behaviour relationship was $r+ = 0.45$ and for the attitude – goal intention and subjective norm – goal intention relationships, they were $r+ = 0.58$ and $r+ = 0.39$, respectively. In the social sciences, it is conventionally accepted that correlations of $r = 0.10$, $r = 0.30$ and $r = 0.50$ represent small-, moderate- and large-sized relationships, respectively (Cohen, 1988 and 1992). The above cited correlations therefore represent large, or approaching large, effect sizes, meaning that the motivational constructs proposed by the theory of reasoned action are good predictors of behaviour generally.

Similarly, in the domain of driving, research has also provided support for the theory of reasoned action. For example, Parker, Manstead, Stradling, Reason and Baxter (1992) found that attitude and subjective norm accounted for 33% of the variance in goal intentions to speed, meaning that the correlation between attitudes and subjective norm, on the one hand, and goal intention, on the other was $r = 0.57$. Other studies have shown that attitudes and subjective norms account for between 14% ($r = 0.37$) and 47% ($r = 0.69$) of the variance in speeding intentions (e.g., Forward, 2009; Parker, Lajunen & Stradling, 1998). Research has also shown that goal intentions are strong predictors of subsequent speeding behaviour, in line with the theory of

reasoned action. For example, Elliott, Armitage and Baughan (2003) showed that speeding intentions accounted for 45% (r = 0.67) of the variance in speeding behaviour. Similarly, Conner et al. (2007) reported two studies in which goal intentions to speed accounted for 23% (r = 0.48) and 17% (r = 0.41) of the variance in subsequent speeding behaviour, respectively. Also, a study by Elliott and Thomson (2010) showed that goal intentions to speed accounted for 47% (r = 0.69) of the variance in speeding behaviour (for similar findings also see Chen & Chen, 2011; Dinh & Kubota, 2013; Elliott, 2012; Elliott, Armitage & Baughan, 2007). Consistent with the findings from studies of other social behaviours, therefore, the motivational constructs in the theory of reasoned action have been found to be strong predictors of speeding behaviour specifically.

2.2.2 The theory of planned behaviour

The theory of planned behaviour (Ajzen, 1985; see figure 2.2) is arguably the most dominant account of behaviour in the literature (Armitage & Conner, 2001). It is an extension of the theory of reasoned action. This model, like its predecessor, specifies that attitudes and subjective norms are independent determinants of goal intentions and that goal intentions are the proximal determinants of behaviour. However, the theory of reasoned action was designed to explain relatively easy to perform behaviours for which the development of a goal intention is sufficient to determine action. It was not designed to account for non-volitional behaviours (i.e., behaviours that are not entirely under an individuals' control; Liska, 1984). The theory of

planned behaviour therefore extends the theory of reasoned action by adding the concept of *perceived behavioural control* (perceived ease or difficulty involved in performing the behaviour; e.g., 'for me, driving faster than the speed limit is easy/difficult') to the framework. Perceived behavioural control is proposed as a determinant of goal intention in addition to attitude and subjective norm. For example, even if an individual has a positive attitude and perceives social pressure to perform a behaviour, s(he) may not form the goal intention to carry out the behaviour if the behaviour is perceived as difficult to perform (i.e., out with the individual's control). Perceived behavioural control is also proposed as a determinant of behaviour in addition to goal intention in the theory of planned behaviour. For example, an individual is unlikely to carry out a behaviour, even if s(he) intends to, if the required ability to perform the behaviour (i.e., behavioural control) is lacking. Therefore, and given that perceived behavioural control takes into account some of the realistic constraints upon behaviour (e.g., Ajzen, 1991; Sheeran, Trafimow & Armitage, 2003) it helps to explain behaviours that are not under complete volitional control.

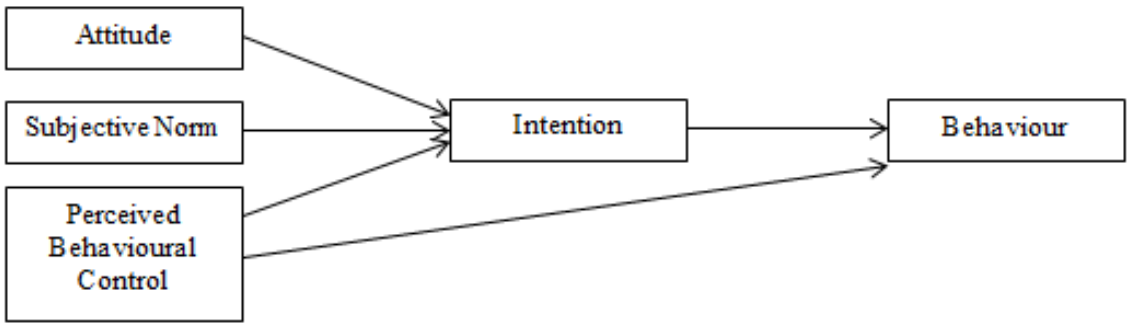

Figure 2.2. The Theory of Planned Behaviour

Perceived behavioural control is likely to be important in the context of speeding because driving speed is known to be influenced by external factors that are often out with an individual's control. For example, other traffic can both restrict driving speed (i.e., if there is congestion on the roads) and facilitate fast driving (i.e., if a driver wants to keep up with surrounding traffic). Also, modern vehicles with low engine noise and vibration provide little feedback to drivers about speed and can make it difficult to avoid speeding (DeWaard, Jessurun, Steyvers, Raggatt & Brookhuis, 1995). Speeding is therefore unlikely to be under a driver's complete volitional control, making the theory of planned behaviour a potentially suitable model for explaining this behaviour.

As is the case for the theory of reasoned action, supporting evidence for the theory of planned behaviour comes from many studies of general social behaviour. For example, $k = 185$ independent theory of planned behaviour studies, conducted across a range of contexts, were included in a meta-analysis by Armitage and Conner (2001). It was found that attitude, subjective norm and perceived behavioural control accounted for 39% of the variance in goal intentions ($r+ = 0.62$) and that goal intentions and perceived behavioural control together accounted for 27% of the variance in behaviour ($r+ = 0.52$). In addition, a meta-analysis of $k = 237$ tests of the theory of planned behaviour by McEachan, Conner, Taylor and Lawton (2011) found that attitude, subjective norm and perceived behavioural control together accounted for 44% of the variance in goal intentions ($r+ = 0.66$) and that goal

intentions and perceived behavioural control together accounted for 19% of the variance in behaviour ($r+ = 0.43$). Importantly, the relative contribution of goal intentions and perceived behavioural control to behaviour were tested in this meta-analysis. While it was found that perceived behavioural control was an important predictor of behaviour ($\beta = 0.11$), goal intention was the bigger predictor ($\beta = 0.37$). Thus, it appears that while perceptions of control are important in determining behaviour generally, motivation (i.e., goal intention) to behave, which is partly informed by perceived behavioural control, is the major predictor.

The theory of planned behaviour has also been shown to be a strong predictor of speeding behaviour specifically. For example, Parker et al., (1992) found that attitude, subjective norm and perceived behavioural control together accounted for 47% ($r = 0.69$) of the variance in drivers' goal intentions to speed and many studies over the last 25 years have found similar results (e.g., Cestac, Paran & Delhomme, 2011; Conner et al., 2007; Elliott et al., 2003; Elliott & Thomson, 2010; Forward, 2009; Paris & Van den Broucke, 2008). Similarly, goal intentions and perceived behavioural control have, together, been found to strongly predict subsequent speeding behaviour. For example, Conner et al. (2007) found that these two constructs together accounted for a significant proportion of the variance in subsequent speeding behaviour in two separate studies. In study 1, they accounted for 31% ($r = 0.56$) of the variance in speeding behaviour and in study 2 they accounted for 19% ($r = 0.44$) of the variance. In line with McEachan et al.'s (2011) meta-analysis,

described above, goal intention was a stronger predictor of behaviour than was perceived behavioural control in both studies (study 1: $\beta = .46$, $p < .05$, for goal intention and $\beta = .30$, $p < .05$ for perceived behavioural control; study 2: $\beta = .35$, $p < .05$, for goal intention and $\beta = -.03$, $p < .05$ for perceived behavioural control). These findings have also been replicated many times (Dinh & Kubota, 2013; Elliott, 2012; Elliott et al., 2003 and 2007; Elliott & Thomson, 2010; Elliott, Thomson, Robertson, Stephenson & Wicks, 2013; Paris & van den Broucke, 2008). As is the case for general social behaviour therefore, perceived behavioural control appears to be important in dictating drivers' speeding behaviour but goal intentions are the major predictors.

2.2.3 Protection motivation theory

Protection motivation theory (Rogers, 1983; see figure 2.3) predicts that people's behaviour is proximally influenced by *protection motivation* (a goal intention that serves to prevent people from performing a potentially harmful or risky behaviour). Protection motivation is, in turn, influenced by thoughts/beliefs about both the harmful or risky behaviour (e.g., speeding) and an alternative recommended, safe behaviour (e.g., driving within speed limits; Floyd, Prentice-Dunn and Rogers, 2000). There are two main components of protection motivation theory. The first is *threat appraisal*, which has three subcomponents. These are: *perceived vulnerability* to the negative consequences of the risky behaviour (e.g., 'I am more likely to be involved in a traffic crash if I am speeding'), *perceived severity* of the negative consequences of the risky behaviour (e.g., 'a traffic crash would be

more severe if I exceeded the speed limit') and *perceived rewards* for performing the risky behaviour, e.g., 'speeding is fun'). The second main component of protection motivation theory is *coping appraisal*. This also has three subcomponents. These are *self-efficacy*, or perceived ability to successfully perform the recommended behaviour (e.g., 'I have the ability to avoid speeding'), *response efficacy*, or the belief that the performance of the recommended behaviour will reduce the threat of negative consequences (e.g., 'avoiding speeding will reduce the likelihood of being involved in a traffic accident') and *perceived costs* associated with performing the recommended behaviour (e.g., 'if I comply with the speed limit, I will be late').

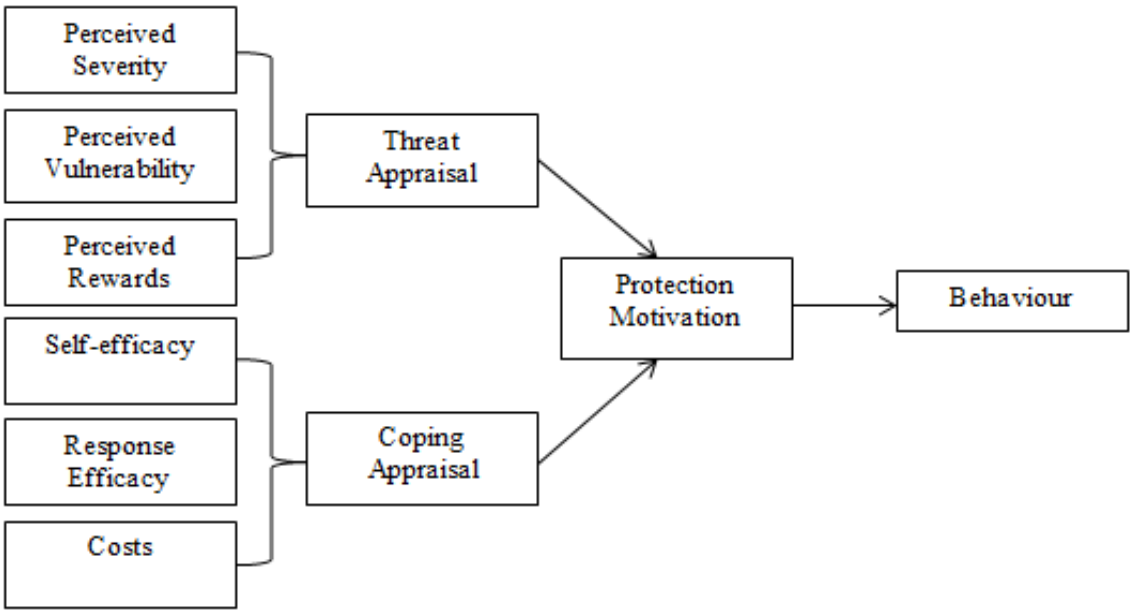

Figure 2.3. Protection Motivation Theory

Protection motivation theory therefore proposes that a goal intention to avoid speeding (i.e., a protective motivation) is likely to be formed when an individual perceives threat from this risky driving behaviour (i.e., high perceived vulnerability and severity to the consequences of speeding and low perceived rewards for this behaviour) and when (s)he perceives that they can 'cope' by performing the recommended alternative behaviour (i.e., high self-efficacy, high response efficacy and low perceived costs for complying with the speed limit). On the other hand, a goal intention to speed will be formed when an individual does not perceive threat from this risky behaviour and when (s)he believes that they cannot perform the recommended alternative (i.e., complying with the speed limit). As is the case for the above cited social cognition models, the goal intention that is formed is proposed by protection motivation theory to subsequently dictate whether a driver will exceed the speed limit or not.

With regards to the evidence for protection motivation theory, two major meta-analyses of health behaviours have been conducted. The first one, by Milne, Sheeran and Orbell (2000), examined $k = 13$ independent studies of health-related behaviours and found that perceived vulnerability, perceived severity, perceived rewards, self-efficacy, response efficacy and perceived costs each had small- to moderate-sized effects in the prediction of both goal intentions, and behaviour, with the sample-weighted average correlations for these relationships ranging from $r+ = 0.07$ to 0.36. Protection motivation (i.e., goal intention), however, had a larger effect in the prediction of

behaviour. When the researchers examined the relationship between goal intention and concurrent behaviour, the sample-weighted average correlation represented a large-sized effect ($r_+ = 0.82$). When they examined the relationship between goal intention and subsequent behaviour, the sample-weighted average correlation approached a large sized effect ($r_+ = 0.40$). In the second meta-analysis, Floyd et al. (2000) examined k =65 studies. Similar results to Milne et al (2000) were found, except that the constructs within protection motivation theory had mainly moderate-to-large relationships with both intentions and behaviour (i.e., $r+ = 0.30$ to 0.50).

Although no studies have examined the correlations between protection motivation theory constructs and driver behaviour, there is one recent study in which protection motivation theory was used to develop an intervention to influence drivers' speeding intentions (Glendon & Walker, 2013). In this study, participants were randomly presented with 18 anti-speeding messages based on protection motivation theory and 18 anti-speeding messages that had been used in previous Australian road safety campaigns. The participants reported their goal intentions to avoid speeding after reading each message. It was found that the participants reported stronger intentions to avoid speeding after reading the anti-speeding messages derived from protection motivation theory than they did after reading the anti-speeding messages from previous road safety campaigns. This provides experimental support for the idea that the motivational constructs within protection motivation theory have a causal

influence on intentions to speed, again highlighting the importance of motivation in the context of driver behaviour.

2.2.4 The prototype willingness model

The prototype willingness model (Gibbons & Gerrard, 1995; see figure 2.4) was designed to explain decisions to engage in health-risk behaviours in adolescents and young adult populations. Consistent with the theory of reasoned action and the theory of planned behaviour, this model proposes that behaviour has a planned or reasoned motivational component in that it can be determined by a goal intention, which is in turn influenced by attitude and subjective norm (Gerrard, Gibbons, Houlihan, Stock, & Pomery, 2008). However, the model also suggests a social reactive component whereby behaviour is determined by *behavioural willingness* (another motivational construct that reflects an openness to engage in risky behaviour given the opportunity; e.g., 'I would be willing to speed if all other drivers around me were speeding'). Behavioural willingness is, in turn, influenced by prototype perceptions (images of the type of person who would perform the behaviour; e.g., 'I resemble the typical person my age that regularly drives faster than the speed limit'). In the context of speeding, this model would suggest that drivers who intend to speed (on the basis of their attitudes and subjective norms) and who are willing to speed (on the basis that they view themselves as representative of the type of person who typically exceeds the speed limit) are likely to subsequently exceed the speed limit. On the other hand, drivers

who do not intend to speed and are unwilling to do so are unlikely to subsequently exceed the speed limit.

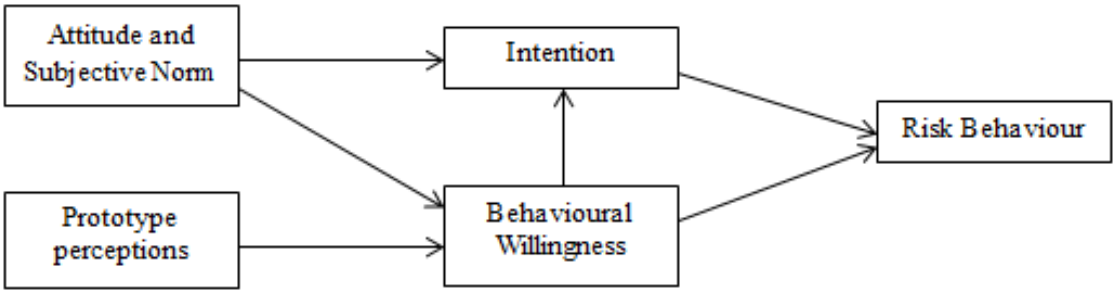

Figure 2.4. The Prototype Willingness Model

The prototype willingness model has received research attention in several studies, although not as many as the theory of reasoned action/planned behaviour. For example, a recent meta-analysis by Todd, Kothe, Mullan and Monds (2014) identified $k = 90$ prototype willingness studies that had been conducted on a range of social behaviours. Attitudes and subjective norms were not examined in this meta-analysis on the basis that theory of planned behaviour research had already established the relationship between these constructs and goal intentions. However, it was found that prototype perceptions accounted for 11% of the variance in behavioural willingness ($r+ = 0.33$). Both goal intention and behavioural willingness accounted for unique variance in behaviour. Goal intention accounted for 16% of the variance in behaviour ($r+ = 0.39$) and willingness explained a further 5% of the variance. Goal intention was a slightly bigger independent predictor of

behaviour (β = .26) than was willingness (β = .23), even though intentions and willingness were closely related (r+ = .54).

The prototype willingness model has also been used to predict young drivers' goal intentions to speed. Chaleshgar, Morowati and Abedini (2013) found that the model accounted for 63% (r = 0.79) of the variance in drivers' (N = 114) speeding intentions. Goal intention, in turn, accounted for 45% (r = 0.67) of the variance in drivers' speeding behaviour and willingness accounted for a further 11% of the variance. Goal intentions were stronger predictors of behaviour (β = 0.67) than was willingness (β = 0.42), although both constructs were closely related (r = 0.61). The research on the prototype willingness model therefore suggests, in line with the other social cognition models outlined above, that motivation is important in determining behaviour both generally and in the context of driving (speeding) specifically.

2.3 Implications of 'motivational research' for educational interventions: The goal intention – behaviour gap and the concept of habit

It can be seen from the above review that numerous theoretical frameworks designed to predict and explain human behaviour rely on the central concept of motivation. The empirical evidence reviewed above also shows that these social cognition models provide good accounts of behaviour and this is not only the case for general social and health behaviours, but for speeding behaviour specifically. In particular, the concept of goal intention (i.e., motivation) is an important determinant of the

performance of speeding behaviour. In other words, the more a driver intends to speed (i.e., the more motivation they have overall to perform this behaviour), the more likely they are to do so. This reasoning implies that educational interventions, which aim to promote the avoidance of speeding by changing drivers' goal intentions and underlying attitudes should be effective at changing behaviour.

The question of why educational interventions have not been shown to be very effective at reducing speeding (see chapter 1) therefore arises. One possibility is that the interventions are inadequate for changing attitudes and goal intentions. For example, educational interventions provide information only (e.g., about the risks of speeding), usually 'at a distance' from the intended recipient of the information through television adverts, posters and other forms of media outlets (e.g., Department for Transport, 2012; Stead et al., 2005). This is unlikely to be an effective strategy for changing behaviour. It is well established in psychology, for example, that attitudes and goal intentions are strong predictors of behaviour (e.g., speeding) when those attitudes and goal intentions have been formed following direct experience of the consequences of the behaviour (e.g., experience of getting to one's destination quickly or narrowly avoiding a traffic crash following an episode of speeding). On the other hand, attitudes and intentions that are based on indirect experience (e.g., being told about the consequences of speeding second hand) are much weaker predictors of behaviour (Fazio & Zanna, 1981). Therefore, any attitudes that are produced after being exposed to educational interventions (i.e., indirect experience of the negative consequences of speeding) are unlikely to translate into behaviour on the road (i.e., the avoidance of speeding).

Another reason why educational interventions might not be effective at reducing speeding, however, is that there is a gap between drivers' goals intentions and their behaviour. This means that educational interventions, which aim to change goal intentions, cannot guarantee a corresponding reduction in speeding behaviour, even if they do effectively change goal intentions and underlying attitudes or other motivational constructs.

Evidence for a gap between drivers' goal intentions and behaviour can be seen from the literature reviewed above on social cognition models. As can be seen from the above review, goal intentions typically account for between 17% and 47% of the variance in drivers' speeding behaviour (e.g., Conner et al., 2007; Dinh & Kubota, 2013; Elliott, 2012; Elliott et al., 2003, 2007; Elliott and Thomson, 2010; Paris & Van den Broucke, 2008). Even when goal intentions are supplemented with additional constructs, such as perceived behavioural control (see section 2.2.2) or behavioural willingness (see section 2.2.4), the proportion of variance accounted for in speeding behaviour is not increased substantially. Although the above cited findings are regarded as moderate-to-large sized effects in the social sciences (Cohen, 1992), and have led some researchers to conclude that interventions targeting goal intentions, and other underlying motivational constructs, are needed to reduce speeding (Conner et al., 2007; Dinh & Kubota, 2013; Forward, 2009), it is clear that about half of the variance in speeding behaviour is typically unaccounted for by goal intentions. This gap between goal intentions and behaviour means that while there is likely to be a large proportion of the driving population that do behave

in accordance with their goal intentions to speed, there are also likely to be many drivers who speed despite having intentions to the contrary.

Research into goal intention–behaviour discrepancies (e.g., Orbell & Sheeran, 1998; Sheeran, 2002), shows that the gap between goal intentions and behaviour is mainly attributable to *inclined abstainers*. These are individuals who intend to perform the required behaviour (i.e., avoid speeding) but abstain from doing so. In the present context, for example, Elliott and Armitage (2006) categorised the participants in a general population sample of drivers (N = 150) according to whether they were regular 'exceeders' of the speed limit (exceeded the speed limit more often than did the median driver in the sample) or regular 'compliers' with the speed limit (exceeded the speed limit less often than did the median driver in the sample). Elliott and Armitage (2006) also categorised these drivers according to whether they had prior goal intentions to speed or avoid speeding. It was found that 24% of the drivers were regular exceeders of the speed limit who had prior goal intentions to speed. Similarly, a substantial proportion of drivers (41%) were regular compliers with the speed limits who had prior goal intentions to avoid speeding. These two groups of drivers therefore account for the correspondences between goal intentions and behaviour that have been observed in previous research. However, Elliott and Armitage (2006) also found that 25% of participants were regular speeders who had prior goal intentions to avoid speeding and 10% were regular compliers who had prior goal intentions to speed. These drivers are therefore responsible for the gap between goal intentions and speeding behaviour that have been observed in the literature. It is also clear from these findings that drivers who regularly exceed speed

limits despite possessing goal intentions to avoid this behaviour (i.e., those who are inclined to avoid speeding but abstain from doing so) are the main reason for the gap. In Elliott and Armitage's (2006) analysis, these drivers accounted for 72% of all drivers who did not behave in line with their goal intentions and just over a half of all drivers who were regular speeders. These findings show that changing drivers' goal intentions (e.g., through educational interventions) will not guarantee a corresponding reduction in speeding behaviour. Additionally, they show that there are a substantial number of drivers for whom intention change does not represent a useful intervention strategy in the first place. This is because they already have the required goal intention to avoid speeding; they just fail to translate that goal intention into action.

The question then arises as to why so many drivers continue to speed despite not intending to do so. The literature on goal intention-behaviour discrepancies offers several possibilities. For example, it has been argued that people often fail to detect appropriate opportunities to perform the desired behaviour when they arise, or they do not know how to act when those opportunities present themselves (e.g., Sheeran, Milne, Webb & Gollwitzer, 2005). It has also been argued that people often simply forget to perform the desired behaviour (e.g., Orbell, Hodgkins & Sheeran, 1997). Furthermore, people often have multiple conflicting goals (e.g., Sheeran et al., 2005), which can interfere with the performance of the desired behaviour (e.g., an immediate goal to not be late for work may conflict with the overall goal to avoid speeding, meaning that the overall goal might be temporarily abandoned). However, in the present context habitual performance of the unwanted behaviour (i.e.,

speeding) appears to be the main reason why many drivers do not translate their generally positive goal intentions to avoid speeding into action.

Habit is a concept that originates from behaviourism (e.g., Skinner, 1938). Habits are defined as learned patterns of behaviour that become automated through repetition (e.g. Ouellette & Wood, 1998; Triandis, 1977; Verplanken & Orbell, 2003). More specifically, a habit is an automatic behavioural response to situational cues that are associated with past behavioural performance. Thus, when a behaviour has been performed repeatedly in the presence of stable situational cues (i.e., when it has been performed repeatedly in the same situation, or a range of similar situations), an association between the situational cues and the behaviour itself is formed. This 'situation-response' link is strengthened with each repetition of the behaviour (cf. Skinner, 1938). Once established, it serves to initiate the behaviour automatically (i.e., rapidly, with little conscious awareness) when the situational cues are subsequently encountered. This means that situational cues are effectively controlling behaviour rather than motivational processes such as goal intentions (e.g., Verplanken, Aarts, Knippenberg & Moonen, 1998). Thus, when a driver who is in the habit of exceeding legal speed limits forms a new goal intention to refrain from speeding (e.g., as a result of maturation, newly acquired experiences, such as a traffic crash or a 'near miss', or an educational intervention), he/she is likely to find it difficult to follow through with that new goal intention because situational cues are still initiating the now unintended behaviour habitually.

In the present context, there is strong evidence to suggest that speeding is habitual. Numerous studies have demonstrated that the frequency with which drivers speed increases with the number of times they have exceeded the speed limit in the past. In fact, past behaviour has repeatedly been found to be the strongest predictor of subsequent speeding behaviour (e.g., Chorlton, Conner & Jamson 2012; Connor & Armitage, 1998; Elliott et al, 2003; Pelsmacker & Janssens, 2007). Furthermore, Elliott and Thomson (2010) formally tested the effects of past behaviour against a range of motivational constructs including goal intentions, on subsequent speeding behaviour, measured six months later. Goal intention was found to be the strongest motivational predictor of speeding behaviour over the next six months ($\beta = .24$, $p < .002$). However, past behaviour ($\beta = .29$, $p < .002$) was a significantly stronger predictor than was any motivational construct. Also, in support of the idea that habits disrupt the translation of motivation into behaviour, past behaviour has also been shown to attenuate the effects of motivation on subsequent behaviour, to the extent that motivational constructs (e.g., attitudes and goal intentions) have been shown to have no effect at all on behavioural performance when people are in the habit of performing a behaviour (e.g., Elliott et al. 2003; Holland, Aarts & Langendam, 2006).

2.4 Conclusions

To conclude, the literature reviewed in this chapter shows that while motivational processes (in particular, goal intentions) are important in determining behaviour, both generally and in the present context specifically, the evidence also shows that they are far from perfect predictors of behaviour. In particular, there is a gap between

goal intentions and behaviour. Of relevance to the research reported in this thesis, the evidence shows that there is a substantial proportion of drivers who have generally positive goal intentions to avoid speeding but do not follow them through. These drivers may often fail to enact their goal intentions because they do not recognise appropriate opportunities to behave when they arise, they do not know how to act when those opportunities arise, they simply forget to perform the required behaviour, or they have conflicting goals that reduce the likelihood of its performance. In particular, the evidence from studies of driver behaviour supports the idea that these drivers exceed speed limits because they are in the habit of speeding. A challenge, therefore, is to develop interventions that are capable of both breaking unwanted habits thereby helping drivers to more easily translate goal intentions (i.e., to avoid speeding) into action.

Chapter 3: Implementation intentions

3.1 Introduction

Chapter 1 shows that speeding increases road traffic crash-risk. However, speeding continues to be a commonly performed driving violation despite interventions to reduce its prevalence. Of particular relevance to this thesis, educational interventions are commonplace. Educational interventions rely on the premise that motivating drivers to avoid speeding (by changing their intentions and underlying attitudes) will engender behaviour-change (e.g., a reduction in on road speeding behaviour). Chapter 2, however, shows that while goal intentions are important determinants of speeding, and many other behaviours, there is a gap between drivers' goal intentions and their behaviour, meaning that interventions to change goal intentions are not sufficient on their own to reduce the prevalence of speeding. Indeed, it has been shown that around half of all drivers who regularly exceed speed limits actually have prior goal intentions to avoid speeding (Elliott & Armitage, 2006). These drivers are therefore already motivated to avoid speeding but they still often abstain from performing the required behaviour. These drivers do not therefore need interventions to change their goal intentions or underlying attitudes. Instead, they need interventions to help them convert their already desirable goal intentions into action (i.e., safe on-road behaviour).

As also discussed in chapter 2, there are a number of possible reasons as to why many drivers are motivated to avoid speeding but do not follow through with their intentions. It was mentioned that these drivers may often fail to enact their goal

intentions because they do not detect appropriate opportunities to do so, they do not know how to go about doing so, they forget to do so, or they have conflicting goals that reduce the likelihood of the intended behaviour (cf. Sheeran et al., 2005; Orbell, Hodgkins & Sheeran, 1997). In particular, driver behaviour is known to be highly habitual (e.g., Chorlton et al., 2012; Connor & Armitage, 1998; Elliott et al, 2003; Elliott & Thomson, 2010; Pelsmacker & Janssens, 2007) and habits are one of the main reasons as to why goal intentions to avoid speeding are unlikely to be converted into action. The previous chapter concludes, therefore, that interventions are needed that can break habits and help drivers with generally positive goal intentions to avoid speeding convert those intentions into action.

In this chapter, the concept of *implementation intentions* (Gollwitzer, 1990) will be introduced. Implementation intentions potentially represent an appropriate strategy for breaking habits and helping people to behave in line with their goal intentions. Implementation intentions could therefore potentially serve as an effective road safety intervention. After describing the concept of implementation intentions and explaining how, theoretically, implementation intentions break habits and convert goal intentions into action, this chapter will review previous research testing the effectiveness of implementation intentions. First, the literature on general social and health behaviours will be reviewed and then the literature in the domain of drivers' speeding behaviour will be considered. In particular, limitations of previous research will be outlined in order to demonstrate the need for the research on implementation intentions that is subsequently reported in this thesis.

3.2 Implementation intentions

The theoretical framework for implementation intentions comes from Heckhausen and Gollwitzer's (1987) model of action phases. According to this model there are two phases that people must go through before they will successfully change their behaviour. The first is a motivational phase. During this phase, people need to develop a goal intention to perform the new behaviour (e.g., a goal intention to avoid speeding). This phase is therefore consistent with the social cognition models outlined in chapter 2, which are also concerned with the development of goal intentions. However, whereas social cognition models propose that the development of a goal intention is the only phase that people need to go through before enacting a behaviour, the model of action phases proposes that people must also go through a second, volitional phase. During this phase, people need to implement the goal intention (i.e., translate it into action).

Implementation intentions are strategies that people can use to change their behaviour in the volitional stage of Heckhausen and Gollwitzer's (1987) model of action phases. Implementation intentions are 'IF-THEN' plans that are designed to facilitate the translation of goal intentions into action (Gollwitzer, 1990). In the 'IF' component of an implementation intention, individuals are required to specify a critical situation in which they will perform an intended behaviour (e.g., a driver who intends to refrain from speeding might specify: "If other vehicles are overtaking me..."). This serves to encode a representation of the specified situation to memory. That mental representation is then 'activated' when the specified critical situation is subsequently encountered. The encountered situation then becomes highly salient.

(Webb & Sheeran, 2004; Webb & Sheeran, 2008 [study 2]). In the 'THEN' component of an implementation intention, an individual is required to mentally associate the specified critical situation with an appropriate goal-directed response (e.g., "THEN I will drive in a lower gear to help me drive slower"). This serves to initiate a suitable strategy for ensuring the performance of the intended behaviour when the mental representation of the specified critical situation has been activated. Additionally, research has shown that the goal-directed response specified in the THEN component of an implementation intention is initiated automatically when the critical situation specified in the IF component is encountered. That is, the goal-directed response is initiated rapidly in response to the critical situation (Gollwitzer & Brandstatter, 1997, study 3; Webb and Sheeran, 2004) with little conscious awareness (Bayer, Achtziger, Gollwitzer & Moskowitz, 2009; Brandstatter, Lengfelder & Gollwitzer, 2001).

Implementation intentions are therefore capable of overcoming the problems discussed in chapter 2 for why people fail to enact their goal intentions. First, given that the specification of a specific critical situation in the IF component of an implementation intention makes that situation become highly salient when it is encountered, implementation intentions make individuals perceptually ready to detect appropriate opportunities to act in the environment. Thus, people are likely to recognise good opportunities to perform their intended behaviours when they arise (e.g., Webb & Sheeran, 2004, 2007 and 2008 [study 2]). Conversely, this is likely to reduce the likelihood that people will forget to perform the required behaviour when good opportunities arise (e.g., Orbell et al., 1997; Sheeran & Orbell, 1999). Second,

given that the THEN component of an implementation intention requires people to specify a goal-directed response to be initiated when the critical situation specified in the IF component is encountered, it means that people are equipped with a strategy of how to act in order to ensure their intended behaviour is performed. Also, given that the goal-directed response specified in the THEN component is initiated automatically when the mental representation of the specified critical situation is activated, implementation intentions help to prevent people from abandoning or postponing performance of the required behaviour (e.g., the avoidance of speeding) when they are faced with conflicting or more immediate goals (e.g., speeding in order to arrive at work on time). This is because the situational cues in the environment, which were originally specified when the implementation intention was formed, effectively control the performance of the desired behaviour rather than the individual's conscious thought processes (Gollwitzer, 1993; Sheeran & Orbell, 1999).

Perhaps most importantly in the context of driving, it is possible that specifying implementation intentions can overcome the influence of habitual behaviour. In fact, it has been argued that implementation intentions operate in a similar way to habits on the basis that their specification leads to situation (IF) – response (THEN) associations (Adriaanse, Gollwitzer, De Ridder, De Wit & Kroese, 2011; Holland et al., 2006). However, with habits, the situation-response associations that serve to automate behaviour (see chapter 2) develop through past behavioural experience, meaning that habits can become counter-intentional (e.g., when goal intentions subsequently change). With implementation intentions, on the other hand, the

situation-response associations develop through conscious thought that takes place with an individual's awareness of their most recent goal intention. This means, therefore, that implementation intentions are goal serving and the automaticity produced by them is strategically aligned with people's goal intentions (Sheeran et al., 2005). This strategic automaticity might therefore be capable of over-riding the automaticity produced by habits (cf. Holland et al., 2006). Implementation intentions might therefore be a useful strategy for reducing speeding.

3.3 Previous research on implementation intentions

Previous research has shown that specifying an implementation intention is an effective strategy for changing behaviour generally. Most notably, a meta-analysis conducted by Gollwitzer and Sheeran (2006) examined $k = 94$ independent studies conducted across a wide variety of social and health contexts including exercise, binge drinking, vitamin use, healthy eating and smoking. The overall finding was that implementation intentions produced moderate- to large-sized changes in behaviour ($d = .65$). Similarly, a meta-analysis of $k = 26$ independent studies conducted in the context of physical activity (Belanger-Gravel, Godin & Amireault, 2013) found that implementation intentions produced small-to-medium-sized levels of behaviour-change ($d = .31$). Also, in a systematic review and meta-analysis of $k = 23$ independent studies examining the effect of implementation intentions on eating a healthy diet (Adriaanse, Vinkers, De Ridder, Hox & De Wit, 2011), it was found that implementation intentions were effective at helping people to eat healthier ($d = .51$) and reduce their intake of unhealthy food ($d = .29$). These effects of implementation intentions on behaviour-change have also not been shown to be attributable to

changes in goal intentions or other motivational constructs (e.g., Sheeran & Orbell, 1999; Sheeran et al., 2005; Webb & Sheeran, 2008 [study 1]). This is consistent with the idea that implementation intentions are volitional behaviour-change strategies (see above). That is, they do not motivate people to change their behaviour. Instead, they simply help people to convert existing motivation to change their behaviour into actual behaviour-change.

However, despite the general support for implementation intentions across a number of behaviours, just one study has tested their ability to reduce speeding. Elliott & Armitage (2006) conducted a randomized controlled experiment. At baseline, all participants completed standard questionnaire measures of their speeding behaviour and their goal intentions to comply with the speed limit on 30mph roads. The participants randomized to the experimental group were also asked, at the end of their baseline questionnaires, to change their behaviour and to specify implementation intentions to comply with speed limits. More specifically, the experimental participants were asked to identify critical situations in which they would comply with speed limits over the following month and goal-directed responses (strategies for avoiding speeding) that they would employ when they encountered those situations. The participants in the control group did not receive this manipulation of implementation intentions at the end of their baseline questionnaires. They completed the measures of goal intention and speeding behaviour only. At follow-up (one month later) all participants completed another questionnaire. The follow-up questionnaire included the same measures of goal intentions and speeding behaviour that were used at baseline.

Consistent with the meta-analyses reported above, Elliott and Armitage (2006) found that the experimental (intervention) group subsequently reported that they complied with 30mph speed limits to a greater extent than did the control group (d = .43) despite the two groups reporting equivalent levels of speeding behaviour at baseline. Additionally, and also in line with studies of general social behaviour, Elliott and Armitage (2006) found that the difference between the experimental and control participants' speeding behaviour was not attributable to changes in goal intentions, implying that implementation intentions helped drivers to translate existing goal intentions to comply with the speed limit into action. Indeed, Elliott and Armitage (2006) conducted moderator analyses which showed that implementation intentions changed behaviour only when participants reported moderate (mean) and high (mean + 1SD) levels of goal intention at baseline. Implementation intentions were not found to change behaviour when participants reported low (mean – 1SD) baseline levels of goal intention to comply with the speed limit.

Given the promising findings of Elliott and Armitage's (2006) research, one of the aims of the research reported in this thesis was to test the effects of implementation intentions on driver behaviour. In addition, given that the strategic automaticity of implementation intentions has the potential to break unwanted habits and help drivers to behave in line with their goal intentions, another aim of the research reported in this thesis was to test whether specifying an implementation intention attenuates the relationship between past speeding behaviour (i.e., habit) and subsequent speeding behaviour, and augments the relationship between goal intentions and subsequent

speeding behaviour. Although Elliott and Armitage (2006) showed that drivers first need to be motivated to comply with speed limits before implementation intentions will lead to a change in speeding behaviour, they did not conduct formal moderator analyses to test these theoretically dictated moderation effects.

Research in other domains has, however, demonstrated that implementation intentions moderate the past-subsequent behaviour relationship. For example, Orbell et al. (1997) found that past behaviour (i.e., behaviour prior to the implementation intention manipulation) was a significant predictor of subsequent breast self-examination for control participants ($\beta = 1.00$, $p < .01$), but not for experimental participants, who specified implementation intentions ($\beta = 0.18$, *ns*). Similarly, Holland et al. (2006) asked experimental participants to specify implementation intentions to recycle old paper and used plastic cups. Recycling behaviour (the amount of paper and plastic cups recycled in participants' dustbins at the end of each working day) was measured 5 days prior to the experimental manipulations, 10 days after the manipulations and finally at two months after the manipulations. The correlations between past and subsequent recycling behaviour were non-significant ($r = .17$, *ns* for recycling paper and $r = -.12$, *ns* for recycling used plastic cups). However, these correlations were significant for the control condition in which participants recycling behaviour was merely observed ($r = .51$ $p < .05$ for recycling paper and $r = .83$, $p < .001$ for recycling used plastic cups). These findings are therefore in line with the idea that implementation intentions weaken the effects of habit on subsequent behaviour.

It has also been demonstrated in other domains that implementation intentions moderate the goal intention-subsequent behaviour relationship in line with the theoretical proposition that implementation intentions help convert existing goal intentions into action. For example, Orbell et al. (1997) asked participants to complete questionnaires measuring goal intentions and other motivational constructs from the theory of planned behaviour with regards to performing breast self-examinations over the next month. Experimental participants were additionally asked to specify implementation intentions to perform breast self-examination during the following month. One month later, all participants were asked to complete a second questionnaire in which they were asked if they had actually conducted a breast self-examination during the study period. Logistic regression showed that goal intention was a significant predictor of subsequent behaviour for the participants who specified implementation intentions, but not for the control participants. This finding could not be attributed to differences in goal intentions prior to the intervention. Therefore, this study shows that specifying implementation intentions helped enable the experimental participants to successfully implement their goal intentions in the volitional stage of Gollwitzer and Heckhausen's (1987) model of action phases. Several other studies in non-driving contexts have provided similar results (e.g., Sheeran & Orbell, 1999, 2000; Sheeran et al., 2005).

Overall, previous research indicates that implementation intentions are an effective strategy for changing behaviour. However, just one study (Elliott & Armitage, 2006) has tested the effects of implementation intentions in the context of driving. This study did not provide any formal (moderator) tests of whether specifying an

implementation intention weakens speeding habits and helps drivers with goal intentions to avoid speeding convert those goal intentions into desirable behaviour. Research in other domains does show however that implementation intentions attenuate the past-subsequent behaviour relationships and augment goal intention-subsequent behaviour relationships. These findings were therefore expected in the present context. In addition, the research that is presented subsequently in this thesis was designed to address several limitations of the existing evidence-base for implementation intentions.

3.4 Limitations of previous research on implementation intentions

There are several potential limitations with the evidence-base for implementation intentions, which are discussed in the following subsections.

3.4.1 Sample composition

As explained earlier in this chapter, implementation intentions are volitional strategies designed to change behaviour by helping individuals translate their existing goal intentions into action. In other words, implementation intentions represent a useful behaviour-change strategy only for individuals who are inclined to perform the required behaviour (e.g., the avoidance of speeding) but abstain from doing so. This is widely acknowledged in the literature on implementation intentions (e.g., Gollwitzer & Sheeran, 2006; Orbell & Sheeran, 1998; Sheeran, 2002). However, researchers have not explicitly sampled *inclined abstainers* in previous studies. There are some studies in which participants have been sampled from *sections* of the population that are

likely to comprise a large number of inclined abstainers. For example, Luszczynska, Sobczyk & Abraham (2007) found that implementation intentions promoted weight loss in overweight women enrolled in a 'Weight Watchers' programme. In this particular study, the participants were likely to have been inclined abstainers; they were likely to have developed the required goal intention to lose weight but, at the same time, they were likely to have had difficulty losing weight (otherwise they would not have been attending a weight loss programme in the first place).

However, the majority of studies have used samples drawn from general populations of students (e.g., Arden and Armitage, 2012; Bamberg, 2000; Milne, Orbell & Sheeran, 2002) or the wider public (e.g., Andersson & Moss, 2011; Armitage, 2009; De Vet, Oenema, Sheeran & Brug, 2009) without screening participants to ensure that they are inclined abstainers. This includes Elliott and Armitage's (2006) study on speeding. These samples will not have been entirely appropriate for testing implementation intentions for two reasons. First, they will have inevitably included some participants who already carried out the required behaviour and therefore had no scope to change (e.g., George, 2004; Harris, Blearley, Sheeran, Barker, Klein, Creswell, Levine & Bond, 2014). In present context, and as mentioned in chapter 1, official statistics from the Department for Transport (2015) show that up to 46% of drivers exceed the speed limit, meaning that up to 54% do not. Similarly, as mentioned in chapter 2, Elliott and Armitage (2006) showed that 51% of their general population sample of drivers regularly complied

with the speed limit. These drivers do not need their behaviour changing. There is little point, therefore, in including them in studies testing the extent to which implementations intentions can reduce speeding.

The second reason why samples drawn from general populations, without prior screening, are not entirely appropriate for testing implementation intentions is that they will include participants who do not possess the required goal intentions for implementation intentions to convert into action. Indeed, several studies show variation in participants' goal intentions with some participants having strong goal intentions to perform the required behaviour, others having moderately strong goal intentions and others having only weak goal intentions (e.g., Elliott & Armitage, 2006; Sheeran et al., 2005). Furthermore, these studies show that implementation intentions change behaviour only for participants with moderate (mean) and high (mean + 1SD) levels of goal intention, not for participants with low (mean -1SD) levels of goal intention. In the present context, there is little point in testing implementations intentions using participants who do not have the pre-requisite goal intention to avoid speeding.

Although participants are not usually screened in studies of implementation intentions to ensure that they are 'suitable for intervention', it is not unusual for researchers in other areas of psychology (e.g., Thomson, Tolmie, Foot, Whelan, Sarvary & Morrison, 2005) or other disciplines (e.g., van Riet-Nales, Schobben, Egberts & Rademaker, 2010) to adopt this practice. In these other

areas, an intervention (e.g., chemotherapy) is typically judged only by its ability to affect the outcomes of participants for whom the intervention is appropriate in the first place (e.g., people with cancer). In the implementation intention literature, the use of samples that do not comprise exclusively of inclined abstainers means that the true effect size of implementation intentions on behaviour-change is likely to have been under-estimated. It is therefore important to separate inclined abstainers (i.e., participants who are appropriate for intervention with implementation intentions) from other participants when testing implementation intentions. This would provide an explicit test of the theoretical proposition that implementation intentions work only for inclined abstainers and, in the present context, it would allow researchers to accurately estimate the effect size of implementation intentions on drivers' speeding behaviour. Inclined abstainers were therefore the focus of the research reported in this thesis.

3.4.2 Control groups

Another potential limitation of previous research on implementation intentions that needs to be addressed is the use of 'passive' rather than 'active' control groups. Virtually all previous implementation intention studies, including Elliott and Armitage's (2006) study on speeding, have used passive control groups, in which participants are not asked to do anything other than complete measures of motivation (e.g., goal intentions) and behaviour. These participants therefore have no explicit demand placed on them to change their behaviour. On the other hand, participants in the

experimental condition are asked to plan to change their behaviour and specify implementation intentions in addition to completing the measures of motivation and behaviour. This raises the possibility that subsequently observed differences in behaviour between conditions could be attributable to a demand, or Hawthorne, effect (e.g. Rosenthal, 1966) rather than implementation intentions.

Very few studies testing implementation intentions have used active control groups (e.g., control groups in which possible experimenter demand is controlled by providing participants with an intervention along with instructions to change their behaviour). One exception is a study by Armitage (2015a). In this study, the experimental participants formed implementation intentions to reduce high calorie snack consumption by linking critical situations in which they would avoid the temptation to eat high calorie snacks (e.g., IF I am tempted to eat high calorie snacks when I am depressed or discouraged) with goal-directed responses (e.g., THEN I will tell myself that if I try hard enough, I can resist temptations to eat high calorie snacks). The active control participants were also asked to specify critical situations and goal-directed responses but they were not asked to form implementation intentions by linking the two. Overall, implementation intentions decreased high calorie snack consumption over the following month (d = 0.29). This finding compares well with other non-driving studies in which active control groups have been used (e.g., Armitage, 2008; Armitage and Arden, 2010, 2012; Armitage, Norman, Noor, Alganem, & Arden, 2014; Conner &

Higgins, 2010). In line with these studies, active control groups were employed in the research presented in this thesis in order to provide a more rigorous test of implementation intentions than most previous research and to more accurately estimate the size of the change in drivers' speeding behaviour that can arise as a result of specifying an implementation intention.

3.4.3 Self-generated implementation intentions

Another limitation of previous studies that focus on real-world behaviours (e.g., speeding) is that researchers typically ask participants to self-generate implementation intentions (i.e., identify their own critical situations in which to perform an intended behaviour and goal-directed responses). However, 20–40% of participants do not adhere to planning instructions when asked to do this (Michie, Dormandy & Marteau, 2004; Rutter, Steadman & Quine, 2006; Skar, Sniehotta, Molloy, Prestwich & Araujo-Soares, 2011). As a result, the quality of participants' implementation intentions can vary substantially (Sniehotta, 2009). For example, in Elliott and Armitage's (2006) study on speeding it was found that some participants identified specific, well defined critical situations (e.g., "IF I feel the need to keep up with traffic") and goal-directed responses (e.g., "THEN I will concentrate more on my speedometer") when specifying their implementation intentions to comply with the speed limit. Other participants, however, specified poorly constructed and overly general implementation intentions (e.g., IF I am driving, THEN I will try to comply with speed limits) that were unlikely to have been activated in response to specific 'problem situations' (e.g., driving

when other traffic is exceeding the speed limit) or provide any useful behaviour-change strategy.

A potential solution to this problem is to use experimenter-provided implementation intentions. This approach is common in laboratory studies and involves giving participants an implementation intention that contains a pre-defined critical situation and goal-directed response. For example, Webb and Sheeran (2004 [study 3]) provided their participants with instructions to press the 'z' key on a keyboard as fast as possible each time a single digit number appears, and the 'm' key as fast as possible each time a multiple digit number appears. Experimental participants were provided with the following implementation intention: "If the number 3 appears on its own, I will respond especially fast!" It was found that these participants subsequently responded faster to the number 3 when it was presented on the computer screen than did the control participants, who had previously only familiarised themselves with the number by filling in the number 3 at certain points on a sheet of paper provided by the experimenter (also see Parks-Stamm, Gollwitzer & Oettingen, 2007; Sheeran et al., 2005 [study 2]).

However, while experimenter provided implementation intentions have been shown to be effective at changing behaviour in laboratory studies, there are several problems with using them to change real-world problem behaviours such as speeding. First, research shows that there is between-person variation in exposure to different contexts, or critical situations, in which these

behaviours are performed. Some drivers, for example, rarely or never experience certain driving situations (e.g., Collia, Sharp & Giesbrecht, 2003). Similarly, research in road safety suggests that there is between-person variation in the effectiveness of behaviour-change strategies, or goal-directed responses, with certain types of behaviour-change strategies being more appropriate for some drivers than others (e.g., Sadler-Smith and Smith, 2004). This means that the same implementation intention is unlikely to be appropriate for all individuals. Also real-world behaviours, such as speeding, can be performed across multiple contexts (e.g., Stradling, 2005; Walker et al., 2009) and are highly automated (e.g., Ouellette & Wood, 1998), meaning that individuals are likely to require more than one implementation intention (i.e., to enable them to deal with more than one critical situation and to provide back-up strategies in case some fail to engender behaviour-change).

Indeed, research has shown that making more than one implementation intention increases the likelihood of successful behaviour-change in real-world contexts. For example, a study by Wiedemann, Lippke & Schwarzer (2012) found that fruit and vegetable intake increased most in participants who formed 4 or 5 implementation intentions. In addition, while Elliott and Armitage (2006) found that the effect of implementation intentions on drivers' speeding behaviour was not sensitive to the number of critical situations that participants specified, these researchers did find that self-reported compliance with speed limits increased to a greater extent when participants specified a greater number of goal-directed responses. More

specifically, Elliott and Armitage (2006) found that the participants who successfully increased their compliance with speed limits over the study period specified, on average, 2.25 goal-directed responses. In contrast, the participants who failed to increase their compliance with speed limits over the study period specified 1.66 goal-directed responses, on average.

A final problem with experimenter provided implementation intentions, as noted by Armitage (2008), is that they are usually identified on the basis of researchers' intuition rather than empirical evidence or theoretically-derived principles of behaviour-change. An approach whereby participants are provided with a range of evidence-based critical situations and theoretically derived goal-directed responses would therefore seem a desirable strategy for helping individuals form effective implementation intentions. A volitional help sheet (e.g., Armitage, 2008) is a potential solution to these problems.

A volitional help sheet is a method for helping individuals link evidence-based critical situations with theoretically derived goal-directed responses, and thereby form effective implementation intentions. The first volitional help sheet was developed by Armitage (2008) as a tool for reducing smoking. Participants were presented with a sheet of paper that comprised a list of critical situations, on the left hand side of the page, and a list of goal-directed responses, on the right. The critical situations were identified from previous research in which the situations associated with smoking had been established (Velicer, DiClemente, Rossi & Prochaska, 1990). Each critical situation was

presented as an ‘if’ statement (e.g., “If I am tempted to smoke at a bar or pub having a drink”). The goal-directed responses were behaviour-change strategies that were derived from Prochaska and DiClemente’s (1983) transtheoretical model. Prochaska and DiClemente’s (1983) transtheoretical model specifies 10 processes (or strategies) that people use to change problem behaviours (also see Prochaska, Velicer, DiClemente & Fava, 1988): (1) consciousness raising (acquiring information about the problem behaviour); (2) self-reevaluation (assessing how you think and feel about yourself with respect to the problem behaviour); (3) self-liberation (choosing and making a commitment to change the problem behaviour and believing in one's ability to do so); (4) counter-conditioning (substituting the problem behaviour with alternatives); (5) stimulus control (avoiding the stimuli that elicits the problem behaviour); (6) reinforcement management (rewarding oneself for changing the problem behaviour); (7) helping relationships (seeking social support for changing the problem behaviour); (8) dramatic relief (experiencing and expressing emotions about the consequences of the problem behaviour); (9) environmental reevaluation (assessing how the problem behaviour affects the physical environment); and (10) social liberation (acknowledging societal support for changing the problem behaviour). Armitage’s (2008) volitional help sheet included two specific goal-directed responses for each process of change. Each goal-directed response was presented as a ‘then’ statement (e.g., “then I will tell myself that if I try hard enough I can keep from smoking”).

In Armitage's (2008) study, the participants selected the critical situations and goal-directed responses that they felt were appropriate for them and formed implementation intentions to quit smoking by drawing lines that linked their chosen critical situations and goal-directed responses. One month later, these participants reported smoking significantly fewer cigarettes and being less nicotine dependent than did control participants (d= 0.55). While similar results have been obtained in a small number of studies on physical activity (Armitage and Arden, 2010), snack consumption (Armitage, 2015a), alcohol consumption (Arden and Armitage, 2012; Armitage, 2015b), there are no studies of driver behaviour in which volitional help sheets have been used to help participants develop implementation intentions.

3.5 Conclusions

In conclusion, the literature reviewed in this chapter shows that implementation intentions have been shown to be an effective intervention strategy for many social and health behaviours (e.g., Adriaanse et al., 2011; Belanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006) including speeding behaviour (Elliott & Armitage, 2006). Previous research out with the context of driving also shows that implementation intentions can attenuate the past–subsequent behaviour relationship and augment the goal intention – behaviour relationship, consistent with the idea that implementation intentions may be suitable for breaking the effects of habit on driver behaviour, thereby allowing drivers with goal intentions to avoid speeding behave in accordance with those goal intentions. However, there are several limitations with the evidence-base for implementation intentions. In particular, previous research has

tested the effects of specifying an implementation intention on behaviour using samples of participants that do not comprise exclusively of inclined abstainers and are therefore not entirely appropriate for this kind of intervention. This is likely to have led to underestimates in the size of the effect that can be achieved when using implementation intentions as a behaviour-change strategy. Researchers have also relied heavily on passive control groups when testing implementation intentions, meaning that the findings of previous studies are potentially vulnerable to experimenter demand biases. Also, in previous research focusing on real-world problem behaviours such as speeding, researchers typically ask participants to self-generate implementation intentions. This can lead to poorly specified implementation intentions that are unlikely to change behaviour. A solution to this problem comes in the form of volitional help sheets, which provide people with evidence-based critical situations and theoretically derived goal-directed responses from which they can form well-specified implementation intentions.

Overall, research is needed to test the effects of implementation intentions using both active control groups and samples that comprise exclusively of inclined abstainers. It would also be useful to develop a volitional help sheet to help drivers form well-specified implementation intentions to avoid speeding. The research reported in the next chapter aimed to address these issues.

Chapter 4: Study 1: Testing the effects of implementation intentions on drivers' speeding behaviour[1]

4.1 Introduction

Thus far in this thesis, it has been demonstrated that there is a need to develop effective interventions to reduce drivers' speeding behaviour (chapter 1), and that those interventions need to break the effects of habit on subsequent behaviour and help drivers with generally positive goal intentions to avoid speeding, convert those goal intentions into action (chapter 2). As discussed in chapter 3, interventions that require drivers to specify implementation intentions can potentially achieve these aims. Although only one previous study has tested the effects of implementation intentions in the context of driving, studies in other domains suggest that implementation intentions can change a range of other behaviours. Research has also shown that implementation intentions attenuate past-subsequent behaviour relationships and augment goal intention-subsequent behaviour relationships, in line with the idea that they can break habits and help convert goal intention into action. However, as also discussed in chapter 3, previous research on implementation intentions is limited for three main reasons. First, studies do not test the effects of implementation intentions using samples that comprise exclusively of inclined

[1] The research reported in this chapter has been published in the following peer reviewed journal paper: Brewster, S.E., Elliott, M.A. & Kelly, S.W. (2015). Evidence that implementation intentions reduce drivers' speeding behaviour: Testing a new intervention to change driver behaviour, *Accident Analysis and Prevention, 74*, 229-242.

This research has also been presented at the International Congress of Applied Psychology: Brewster, S.E., Elliott, M.A. & Kelly, S.W. Testing a new intervention to promote implementation intentions to refrain from speeding. 28th International Congress of Applied Psychology, Paris, France (8-13 July, 2014).

abstainers, even though these are the only people in the population who are appropriate for an implementation intentions intervention. Second, passive rather than active control groups have been used in the majority of previous studies, meaning that the observed changes in behaviour may be due to experimenter demand rather than implementation intentions. Third, participants are generally asked to self-generate their own implementation intentions, which can lead to poorly specified plans. On the other hand, volitional help sheets provide participants with a range of evidence-based critical situations and theoretically derived goal-directed responses, which can be used to form well-specified implementation intentions that are likely to be effective at changing behaviour.

The research reported in this chapter therefore aimed to test the effects of implementation intentions on drivers' speeding behaviour and address the above limitations with the existing evidence-base. It was hypothesised that: (1) a group of experimental participants, who used a volitional help sheet (see appendix A) to form implementation intentions to avoid speeding, would subsequently report exceeding the speed limit less frequently than would a group of active control participants; (2) this difference would be specific to inclined abstainers; (3) past behaviour would be a weaker predictor of subsequent speeding for the experimental participants than it would for the control participants; and (4) goal intentions to speed would be stronger predictors of subsequent speeding for the experimental participants than they would for the control participants.

4.2 Method

4.2.1 Participants

Participants were recruited from: (a) a University in Glasgow (a large city in the West of Scotland), using advertisements placed on notice boards and virtual learning environments and by making announcements in lectures; (b) other UK universities, using a national postgraduate mailing list; (c) several local businesses in Glasgow (e.g., supermarkets, post offices, cafes, gift shops and travel agents), using leaflets handed out to staff and customers; and (d) UK online driving discussion forums, using messages asking for volunteers. A total of 300 drivers volunteered to take part in the study and 243 of them completed it (81% completion rate). All participants were aged 17 years old or over and held a full UK driving license. The mean age of the sample was 35.58 years old (SD = 14.20; range = 17–71 years) and 46.9% was male (n = 114). The mean weekly mileage was 134.11 (SD = 154.28; range = 4–1200 miles) and the mean number of years that participants were licensed to drive was 15.41 (SD = 13.25; range = 0.5–47 years).

4.2.2 Design and procedure

Ethical approval for conducting this study was awarded by the ethical committee within the University's School of Psychological Sciences and Health. A randomised-controlled design was used. Participants were randomly allocated to either an experimental condition (n = 117) or an active control condition (n = 126). All participants were told that the project was a general purpose investigation into drivers' attitudes toward speeding. At

baseline all participants completed a questionnaire that measured basic demography (age, gender, weekly mileage, and number of years licensed to drive) and contained standard items that are commonly used in the social sciences to measure goal intentions and behaviour (see Fishbein and Ajzen, 2010). The key motivational pre-cursors of goal intentions that are specified in the theory of planned behaviour (i.e., attitudes, subjective norms and perceived behavioural control; Ajzen, 1991) were also measured because they have been shown to possess predictive validity across numerous contexts, including driving (see chapter 2). Where possible, participants completed a paper-and-pencil copy of the questionnaire in a laboratory within the School of Psychological Sciences and Health. Participants who were not local to Glasgow completed an online version of the questionnaire.[2] The paper-and-pencil and online questionnaires contained identical items to measure behaviour, goal intention, attitude, subjective norm and perceived behavioural control.

At the end of the baseline questionnaire, the experimental participants received a volitional help sheet designed to promote implementation intentions to avoid speeding (see next subsection). Active control participants received, instead, information taken from the UK Department for Transport's THINK! campaign about the risks of speeding and government advice on how to drive safely (Department for Transport, *n.d.*).

[2] Note that the analyses presented in the main text were run on the participants who completed the paper-and-pencil questionnaire and the participants who completed the online questionnaire, separately. The findings were the same for both sets of participants and therefore all participants were analysed together.

After approximately one month, all participants completed a follow-up questionnaire. The follow-up questionnaire included identical items to the baseline questionnaire to measure speeding behaviour, goal intentions and the motivational pre-cursors of goal intentions. The follow-up questionnaires were administered using the same mode of participation that was used at baseline (i.e., participants who completed a paper-and-pencil questionnaire at baseline also completed a paper-and-pencil questionnaire at follow-up and participants who completed an online questionnaire at baseline also completed an online questionnaire at follow-up). All baseline and follow-up questionnaires were successfully matched using self-generated unique codes that were derived by asking each participant to state their initials and the first letter of their mother's maiden name on both questionnaires.

4.2.3 The volitional help sheet

In line with research in other domains (e.g., Armitage, 2008; Armitage and Arden, 2010, 2012), the volitional help sheet used in this study comprised a list of 20 critical situations and a list of 20 goal-directed responses from which participants were asked to specify implementation intentions. The 20 critical situations were identified from the literature on driver behaviour (e.g., Beilinson, Glad, Larsen & Aberg, 1994; Fitzgerald, Harrison, Pronk & Fildes, 1998; Stradling, 2005; Walker et al., 2009). They were situations in which drivers are known to speed frequently or report difficulties complying with speed limits. Each critical situation was presented as an ‘if’ statement (see

Table 4.1). The 20 goal-directed responses were theoretically derived behaviour-change strategies from Prochaska and DiClemente's (1983) transtheoretical model. As explained in the previous chapter, this model specifies 10 processes that people can use to change their behaviour (see Prochaska et al., 1988): (1) consciousness raising (acquiring information about the problem behaviour); (2) self-reevaluation (assessing how you think and feel about yourself with respect to the problem behaviour); (3) self-liberation (choosing and making a commitment to change the problem behaviour and believing in one's ability to do so); (4) counter-conditioning (substituting the problem behaviour with alternatives); (5) stimulus control (avoiding the stimuli that elicits the problem behaviour); (6) reinforcement management (rewarding oneself for changing the problem behaviour); (7) helping relationships (seeking social support for changing the problem behaviour); (8) dramatic relief (experiencing and expressing emotions about the consequences of the problem behaviour); (9) environmental reevaluation (assessing how the problem behaviour affects the physical environment); and (10) social liberation (acknowledging societal support for changing the problem behaviour). The volitional help sheet included two goal-directed responses for each process of change. Each goal-directed response was presented as a 'then' statement (see Table 4.1). The specific wording of these statements was informed by previously published research, which has identified standard items to measure each process of change in relation to health behaviours: smoking cessation (e.g., Armitage, 2008; Prochaska et al., 1988); increasing fruit and vegetable intake (Oliveira, Anderson, Auld &

Kendall 2005); exercise (Armitage and Arden, 2010); and binge drinking (Arden and Armitage, 2012). The most appropriate items from these previous studies were selected and adapted to suit the present target behaviour.

Table 4.1. The critical situations and goal-directed responses on the volitional help sheet and the proportion of participants who specified each one

Critical Situations/Goal-Directed Responses	%
Critical Situations ('If I am tempted to speed…')	
…when I am late or in a hurry to get somewhere (e.g. work/university/an appointment/to meet friends)	59.8
… in order to keep up with surrounding traffic	38.5
… when I am on a long journey	37.6
… when under pressure from another driver following close behind me	34.2
… when driving on quiet roads with little or no traffic	34.2
… after I have been 'stuck' behind a slow moving vehicle	25.6
… in order to get through traffic lights that have started to turn against me	23.9
… when driving on roads which I think should have higher speed limits	22.2
… when driving on familiar roads	22.2
… when I feel like there is little chance of being caught for speeding	15.4
… after I have been 'stuck' in stationary traffic	14.5
… when another driver is putting on the pressure to drive faster by flashing their headlights/sounding their horn	12.8
… when being overtaken by other traffic/another vehicle	11.1
… when I am feeling stressed	11.1
… when I am listening to certain types of music in the car	9.4
… when driving past a school	4.3

Table 4.1 (continued). The critical situations and goal-directed responses on the volitional help sheet and the proportion of participants who specified each one

Critical Situations/Goal-Directed Responses	%
… when driving down a road with parked cars	3.4
… when passengers are encouraging me to drive faster (overtly or otherwise)	2.6
… when I feel the urge to show-off or assert myself	1.7
… when I feel like the car 'wants' to go faster	1.7
Goal-Directed Responses ('Then I will…')	*%*
… remind myself that I am not saving much time by speeding (CR)	42.7
… remind myself that drivers caught for speeding (e.g. by the police or safety cameras) face sanctions (SocLib)	41.9
… think about the emotional pain I would suffer if my speeding caused a death or injury to someone (DR)	34.2
… make a concerted effort to ignore the urge/pressure to speed (CC)	33.3
… rather than speed, I will try to relax and drive in a more careful/considerate/responsible manner (CC)	29.9
… remember how upsetting it is to see/hear about road traffic crashes caused by speeding motorists, and the distress caused to the victims and their families (DR)	29.9
… tell myself that I have the ability to comply with speed limits if I want to (SL)	23.1
… try to avoid putting myself in that situation again in the future (SC)	18.8
… remind myself that speeding increases my fuel consumption, which is bad for the environment and costs me money (ER)	13.7
… remember that I have made a commitment to avoid speeding (SL)	12.8
… tell myself that although it might be an easy and enjoyable thing to do, speeding is a harmful and dangerous habit (CR)	12.0
… remember that speeding contradicts the view I have of myself as a considerate person (SR)	11.1

Table 4.1 (continued). The critical situations and goal-directed responses on the volitional help sheet and the proportion of participants who specified each one

… tell myself that society is becoming less accepting and tolerant of speeding (SocLib)	6.8
… tell myself how skillful a driver I am to be able to control my vehicle within the speed limit (RM)	6.8
… remember that there are people in my life who are supportive of me complying with speed limits (HR)	6.0
…think about how disappointed I would be in myself if I drove faster than the speed limit (SR)	4.3
… remember to tell myself that I am a good driver if I do not speed (RM)	4.3
… remind myself that speeding increases my vehicle emissions, which pollute the environment (ER)	3.4
… drive in a lower gear to help me drive slower (SC)	2.6
… seek advice from people in my life (e.g. more experienced or calm drivers) about how to avoid speeding in such situations in the future (HR)	0.9

Notes. Acronyms in parentheses indicate the processes of change (Prochaska & DiClemente, 1988) that the goal-directed responses were designed to tap: CR = Consciousness Raising; ER = Environmental Reevaluation; DR = Dramatic Relief; SocLib = Social Liberation; SR= Self Reevaluation; SL = Self Liberation; HR = Helping Relationships; CC = Counter Conditioning; RM = Reinforcement Management; SC = Stimulus Control

The experimental participants' task was to choose up to four critical situations from the volitional help sheet and to link each one with an appropriate goal-directed response. The participants were told to choose the critical situations in which they thought they would be most tempted to speed over the next month. They were also told that they could link each of their chosen situations with the same goal-directed response or a different one. Those who completed the paper-and-pencil questionnaires made these links by drawing a line between their chosen critical situations and goal-directed responses. The participants who completed the online questionnaires were asked to select pairs of critical situations and goal-directed responses from drop-down menus.

All participants were therefore asked to specify up to four implementation intentions. As discussed in chapter 3, Elliott and Armitage (2006) showed that drivers who were successful at increasing their compliance with speed limits specified a greater number of goal-directed responses in their implementation intentions than did participants who were not successful at increasing their compliance with speed limits. It has also been demonstrated in other behavioural domains that specifying a larger number of implementation intentions leads to a larger change in behaviour. More specifically, Wiedemann et al. (2012) found that only participants who formed four or five implementation intentions significantly increased their fruit and vegetable intake. However, as noted by Webb (2006), there is a risk that specifying too many implementation intentions could weaken each

individual association between the critical situations and goal-directed responses and could interfere with efficient encoding and retrieval of the plans. In other words, the effects of each implementation intention could be diluted with each additional plan. Therefore, the maximum number of implementation intentions that participants specified in this study was four.

Table 4.1 shows the percentage of participants selecting each critical situation and goal-directed response on the volitional help sheet. The most commonly selected critical situations were: 'If I am tempted to speed when I am late or in a hurry to get somewhere' (59.8%), and 'If I am tempted to speed in order to keep up with surrounding traffic' (38.5%). The least commonly selected were: 'If I am tempted to speed when I feel the urge to show off or assert myself' (1.7%) and 'If I am tempted to speed when I feel like the car 'wants' to go faster' (1.7%). The goal-directed responses most frequently chosen were: 'Then I will remind myself that I am not saving much time by speeding' (42.7%) and 'Then I will remind myself that drivers caught for speeding (e.g., by the police or safety cameras) face sanctions' (41.9%). The goal-directed responses selected least frequently were 'Then I will seek advice from people in my life about how to avoid speeding in such situations in the future' (0.9%) and 'Then I will drive in a lower gear to help me drive slower' (2.6%).

4.2.4 Measures

Speeding behaviour and goal intention to speed

Speeding behaviour was measured at both baseline and follow-up by asking participants: "Over the last month, how often have you found yourself driving faster than the speed limit...?" Participants completed this item with regards to each of the 20 critical situations specified on the volitional help sheet, separately (see Table 4.1) using a 9 point scale from 'never' (scored 1) to 'all the time' (scored 9). The mean of the 20 behaviour items produced a final measure of speeding behaviour that possessed high internal reliability for both the experimental condition (α = .91 at baseline; .93 at follow-up) and the control condition (α = .94 at baseline; .94 at follow-up).

Goal intention was measured using five items: "I plan to drive faster than the speed limit over the next month" (1 = strongly disagree to 9 = strongly agree); "How likely or unlikely is it that you will drive faster than the speed limit over the next month?" (1 = extremely unlikely to 9 = extremely likely); "I intend to drive faster than the speed limit over the next month" (1 = definitely no to 9 = definitely yes); "I would like to drive faster than the speed limit over the next month" (1 = strongly disagree to 9 = strongly agree); and "I want to drive faster than the speed limit over the next month" (1 = strongly disagree to 9 = strongly agree). The mean of these five items was taken to produce a final measure of goal intention to speed (experimental condition: α =

.91 at both baseline and follow-up; control condition: α = .90 at baseline and α = .91 at follow-up).

On the basis of the final measures of speeding behaviour and goal intention, participants were classified as being either suitable for intervention (i.e., inclined abstainers; *n* = 110 [*n* = 56 experimental participants; *n* = 54 controls]) or unsuitable for intervention (i.e., all other participants; *n* = 133: [*n* = 61 experimental participants; *n* = 72 controls]). More specifically, participants were coded as suitable for intervention (scored 1) if their baseline behaviour score was greater than their baseline goal intention score. In other words, these participants reported speeding more than they intended to at baseline meaning that there was scope to reduce their speeding behaviour to their specified levels of goal intention. All other participants were coded as unsuitable for intervention (scored 0). In other words, their baseline behaviour score was less than or equal to their baseline goal intention score, meaning that they reported speeding less often than they intended to or as much as they intended to at the outset of the study and therefore there was no scope, theoretically, to reduce their speeding.

The motivational pre-cursors of goal intention

Attitudes toward speeding were measured with five items. Participants were presented with the stem: “For me, driving faster than the speed

limit over the next month would be… ". They completed this stem using five semantic differential scales: extremely bad (scored 1) to extremely good (scored 9); extremely negative (scored 1) to extremely positive (scored 9); extremely dull (scored 1) to extremely fun (scored 9); extremely unpleasant (scored 1) to extremely pleasant (scored 9); and extremely foolish (scored 1) to extremely wise (scored 9). The mean of these five attitude items served as a reliable final measure of attitude for both the experimental condition (α = .90 at baseline; .91 at follow-up) and the control condition (α = .90 at baseline; .87 at follow-up).

Subjective norm was measured with two items: "How often will the people who are important to you drive faster than the speed limit over the next month?" (1 = never to 9 = very often) and "Of the people you know, how many do you think will drive faster than the speed limit over the next month?" (1 = none of them to 9 = all of them). The mean of the two subjective norm items was used as the final measure of subjective norm (experimental condition: r = .54, p < .001 at baseline and r = .67, p < .001 at follow-up; control condition: r = .49; p < .001 at baseline and r = .51; p < .001 at follow-up).

Perceived behavioural control was measured with seven items: "For me, avoiding driving faster than the speed limit over the next month would be…" (1 = extremely difficult to 9 = extremely easy"); "How

confident are you that you will be able to avoid driving faster than the speed limit over the next month?" (1 = not at all confident to 9 = extremely confident); "How much will factors outside your control influence whether or not you drive faster than the speed limit over the next month" (1 = a lot to 9 = not at all); "How much personal control do you feel that you have over whether or not you will drive faster than the speed limit over the next month?" (1 = no control at all to 9 = complete control); "I believe that I have the ability to avoid driving faster than the speed limit over the next month" (1 = strongly disagree to 9 = strongly agree); "Whether or not I drive faster than the speed limit over the next month is under my control" (1 = strongly disagree to 9 = strongly agree); and "To what extent do you see yourself as being capable of avoiding driving faster than the speed limit over the next month?" (1 = not at all capable to 9 = very capable). The mean of these seven items served as the final measure of perceived behavioural control for both the experimental condition (α = .75 at baseline and α = .84 at follow-up) and the control condition (α = .73 at baseline and α = .84 at follow-up).

4.3 Results

4.3.1. Power analysis

A power analysis was performed to ensure that the sample was sufficient to detect a meaningful sized effect. Power was calculated using *N*=110 because *N*=110 was the number of participants who were deemed suitable for

intervention (see section 4.2.4). Also, the number of participants who were not deemed suitable for intervention was *N*=133. Any analysis conducted on these participants would therefore be sufficiently powered so long as *N*=110 provided sufficient power. The power analysis revealed that the power of the study to detect an effect size of $f^2 = 0.30$ (i.e., a meaningful sized effect, somewhere between a moderate and large effect size) at $\alpha = 0.05$ was 0.88. Given that this power was greater than 0.80, it was concluded that the present analyses had sufficient power to detect a meaningful sized effect (cf. Cohen, 1988, 1992).

4.3.2. Tests of attrition and randomization

A series of ANOVAs was conducted to test whether there were any baseline differences between participants who dropped out of the study at follow-up (*n* = 57) and those who completed it (*n* = 243). The dependent variables in these analyses were the baseline measures of behaviour, goal intention and the motivational precursors of goal intention. The independent variables in each analysis were attrition (0 = dropped out of the study at follow-up; 1 = completed the study) and suitability for intervention (0 = unsuitable for intervention; 1 = suitable for intervention). These analyses revealed no significant main effects of attrition or interactions between attrition and suitability for intervention (see Table 4.2). Therefore, there were no baseline differences between those who dropped out of the study at follow-up and those who completed it on any of the measures, and that was the case for both the participants who were suitable for intervention and the participants who

were unsuitable for intervention. The following analyses were therefore conducted on the final sample only.

Table 4.2. ANOVAs testing the effects of attrition and suitability for intervention on the baseline measures of behaviour, goal intention and the motivational pre-cursors of goal intention

Dependent Variable	*F*	*MSE*	*d*
Attrition (0 = Dropped out at follow-up; 1 = Completed both baseline and follow-up)			
Behaviour	0.22	2.37	-0.07
Goal Intention	0.03	3.81	-0.03
Attitude	0.04	2.57	-0.03
Subjective Norm	2.17	2.86	0.23
Perceived Control	0.96	1.73	0.15
Suitability for Intervention (0 = Unsuitable for intervention; 1 = Suitable for intervention)			
Behaviour	7.23*	2.37	-0.12
Goal Intention	59.50**	3.81	1.27
Attitude	27.90**	2.57	0.80
Subjective Norm	3.10	2.86	0.30
Perceived Control	0.09	1.73	-0.21
Attrition x Suitability for Intervention			
Behaviour	3.63	2.37	-0.30
Goal Intention	0.18	3.81	-0.07
Attitude	0.04	2.57	0.03
Subjective Norm	0.02	2.86	0.23
Perceived Control	2.48	1.73	0.24

*$p < .01$. **$p < .001$. All *df*s = 1, 296.

Another series of ANOVAs was conducted to test whether participants had been successfully randomized to the conditions. The dependent variables were the baseline measures of behaviour, goal intention and the motivational precursors of goal intention. The independent variables were condition (0 = control; 1 = experimental) and suitability for intervention (0 = unsuitable for intervention; 1 = suitable for intervention). These ANOVAs revealed no significant main effects of condition or interactions between condition and suitability for intervention (see Table 4.3). This means that there were no detectable differences between the experimental and control conditions at baseline, and that was the case both for the participants who were deemed suitable for the intervention and for those deemed unsuitable for the intervention. Randomization to the experimental and control conditions was therefore deemed to have been successful.

Table 4.3. ANOVAs testing the effects of condition and suitability for intervention on the baseline measures of behaviour, goal intention and the motivational pre-cursors of goal intention

Dependent Variable	*F*	*MSE*	*d*
Condition (0 = Control; 1 = Experimental)			
Behaviour	0.00	2.34	0.01
Goal Intention	0.21	3.42	0.06
Attitude	0.19	2.38	-0.06
Subjective Norm	0.36	2.91	0.08
Perceived Control	0.51	1.69	0.09
Suitability for Intervention (0 = Unsuitable for intervention; 1 = Suitable for intervention)			
Behaviour	0.83	2.34	-0.12
Goal Intention	106.02**	3.42	1.34
Attitude	40.79**	2.38	0.83
Subjective Norm	5.15*	2.91	0.29
Perceived Control	2.59	1.69	-0.21
Condition x Suitability for Intervention			
Behaviour	1.07	2.34	-0.13
Goal Intention	0.43	3.42	-0.08
Attitude	1.80	2.38	-0.17
Subjective Norm	1.17	2.91	-0.14
Perceived Control	0.40	1.69	0.08

*$p < .05$. **$p < .001$. All *df*s = 1, 239.

4.3.3. Descriptive statistics

The means and standard deviations for all measures are shown in Table 4.4 for the suitable and unsuitable for intervention participants, separately. Participants were not, in general, highly motivated to exceed the speed limit. The sample means on the baseline and follow-up measures of both goal intention and attitude were around or just below the scale mid-points. This indicates that participants, on average, did not report strong intentions to speed or particularly positive attitudes toward speeding. The means on the measures of subjective norm were just above the scale mid-points at both baseline and follow-up, indicating that participants perceived only moderate amounts of social pressure to exceed the speed limit. The baseline and follow-up means for perceived behavioural control were toward the top of the scale, indicating that participants reported that they could easily avoid driving faster than the speed limit. The mean score on the measure of speeding behaviour shows that participants, on average, reported moderate levels of speeding. However, within the suitable for intervention sub-sample, the mean on the measure of speeding behaviour was lower at follow-up for the experimental condition (M = 3.24) than it was for the control condition (M = 4.00), in line with hypothesis 1. On the other hand, within the unsuitable for intervention sub-sample, there was very little difference between the conditions in the measure of speeding behaviour (M = 3.74 for the experimental condition; M = 3.66 for the control condition).

Table 4.4. Means (SDs) and ANCOVAs testing the differences between the participants who were suitable and unsuitable for intervention on the measures of speeding behaviour, goal intention and the motivational pre-cursors of goal intention

Variable	Time	Suitable for intervention					Unsuitable for intervention				
		M (*SD*)		ANCOVA			*M* (*SD*)		ANCOVA		
		Cont (*N* = 54)	Exp (*N* = 56)	*F* (1, 107)	*MSE*	*d*	Cont (*N* = 72)	Exp (*N* = 61)	*F* (1, 130)	*MSE*	*d*
Behaviour	Baseline	4.08 (1.57)	3.87 (1.51)	15.89*	0.63	-0.76	3.69 (1.69)	3.89 (1.28)	0.30	0.89	-0.09
	Follow-up	4.00 (1.48)	3.24 (1.34)				3.66 (1.69)	3.74 (1.38)			
Goal Intention	Baseline	2.96 (1.45)	2.69 (1.47)	0.01	0.91	-0.02	5.26 (2.30)	5.30 (1.87)			
	Follow-up	3.07 (1.48)	2.84 (1.54)				4.59 (2.41)	4.90 (2.19)	-	-	-
Attitude	Baseline	3.53 (1.54)	3.35 (1.52)	3.81	0.90	-0.38	4.53 (1.58)	4.89 (1.51)			
	Follow-up	3.51 (1.31)	3.03 (1.49)				4.32 (1.68)	4.71 (1.83)	-	-	-
Subjective Norm	Baseline	5.87 (1.90)	5.50 (2.09)	1.70	1.33	0.25	6.13 (1.52)	6.24 (1.30)			
	Follow-up	5.71 (1.58)	5.75 (1.95)				5.93 (1.66)	6.07 (1.61)	-	-	-
Perceived Control	Baseline	6.96 (1.19)	6.94 (1.28)	2.27	0.95	0.29	6.79 (1.36)	6.56 (1.34)			
	Follow-up	6.71 (1.37)	6.98 (1.25)				6.84 (1.65)	6.81 (1.41)	-	-	-

Note. ANCOVAs were not conducted on the measures of motivation to speed for the unsuitable for intervention group because there was no significant difference on the measure of behaviour. Cont = Control condition. Exp = Experimental condition. * $p < .001$.

4.3.4. Effects of implementation intentions on reported speeding behaviour

A two-way ANCOVA was conducted to simultaneously test hypothesis 1 (that experimental participants, who form implementation intentions, will subsequently report exceeding the speed limit less frequently than will active control participants) and hypothesis 2 (that the difference in speeding behaviour between experimental and control participants will be specific to inclined abstainers). The dependent variable in the analysis was the follow-up measure of speeding behaviour. The independent variables were condition (0 = control; 1 = experimental) and suitability for intervention (0 = unsuitable; 1 = suitable). The covariate was the baseline measure of speeding behaviour.

In support of hypothesis 1, the ANCOVA revealed a significant main effect of condition, F (1, 241) = 9.07, $p < .01$, MSE = 0.77, d = 0.39, with the estimated marginal means showing that the experimental participants reported exceeding the speed limit less frequently (M = 3.32; SE = 0.11) than did the control participants (M = 3.92; SE = 0.11). Suitability for intervention was not statistically significant, F (1, 240) = 3.78, *ns*, MSE = 0.77, d = 0.25. In line with hypothesis 2, however, there was a significant interaction between condition and suitability for intervention, F (1, 239) = 5.11, $p < .05$, MSE = 0.77, d = 0.30. This interaction was decomposed by running separate ANCOVAs on the suitable and unsuitable for intervention sub-samples (see top row of Table 4.4). As expected, the analysis of the suitable for intervention sub-sample showed that the experimental participants reported

exceeding the speed limit less often than did the control participants. The analysis of the unsuitable for intervention sub-sample showed that there was no difference in the measure of speeding behaviour between the experimental and control participants.

To ensure that the difference in speeding behaviour between the experimental and control participants was not attributable to any post-intervention differences in goal intentions or the other motivational constructs measured in this study, another series of ANCOVAs was conducted. These ANCOVAs were conducted on the suitable for intervention sub-sample only (i.e., the sub-sample for which there was a difference between experimental and control participants' speeding behaviour). The dependent variables in these analyses were the follow-up measures of goal intention and the motivational pre-cursors of goal intention. The covariates were their baseline counterparts. The independent variable in each analysis was condition. These analyses revealed no significant effects of condition on goal intention, attitude, subjective norm or perceived control (see Table 4.4). Therefore, the effects of implementation intentions on reported speeding behaviour could not be attributed to any changes in motivation to speed.[3]

A supplementary analysis was conducted to gauge whether the effects of implementation intentions on reported speeding behaviour were specific to the critical situations that participants specified in the IF component of their

[3] Note that there were no differences between the conditions in the follow-up measures of motivation for the unsuitable for intervention sub-sample either.

plans or whether the effects might potentially generalize to situations that participants did not specify. Whilst this was not an original aim of the study, the data did permit a test of the baseline to follow-up changes in reported speeding behaviour in the situations that the experimental participants specified in their implementation intentions relative to those situations they did not specify (note that these changes could not be tested against the data from the control participants because the control participants did not specify implementation intentions; I return to this issue in the discussion). First, baseline and follow-up measures of speeding behaviour in the specified critical situations were derived for each experimental participant by taking the mean of the speeding behaviour items that corresponded to those critical situations that were selected on the volitional help sheet. Next, baseline and follow-up measures of speeding behaviour in the unspecified critical situations were derived by taking the mean of the remaining items. A repeated measures ANOVA was then conducted. Baseline versus follow-up speeding behaviour in the specified critical situations was the first repeated measure. Baseline versus follow-up speeding behaviour in the unspecified critical situations was the second repeated measure.

The ANOVA showed that both repeated measures were statistically significant: F (1, 55) = 36.56, $p < .001$ for baseline versus follow-up speeding behaviour in the specified critical situations; and F (1, 55) = 149.58, $p < .001$ for baseline versus follow-up speeding behaviour in the unspecified situations. As figure 4.1 shows, reported speeding behaviour reduced

significantly in both the specified and unspecified situations. However, there was also a significant interaction between the two repeated measures, F (1, 55) = 13.08, p = .001. This interaction was unpacked using the following procedure. Baseline to follow-up changes in speeding behaviour were calculated for the specified and unspecified situations, separately (i.e., follow-up speeding behaviour minus baseline speeding behaviour). A paired samples t-test was then conducted on the two results difference scores. This showed that the reduction in the measure of speeding behaviour from baseline to follow-up was significantly bigger for the specified situations (M = -1.07; SD = 1.34) than the unspecified situations (M = -0.52, SD = 0.89), t(55) = -3.62, p = .001. This interaction is also shown graphically in figure 4.1.

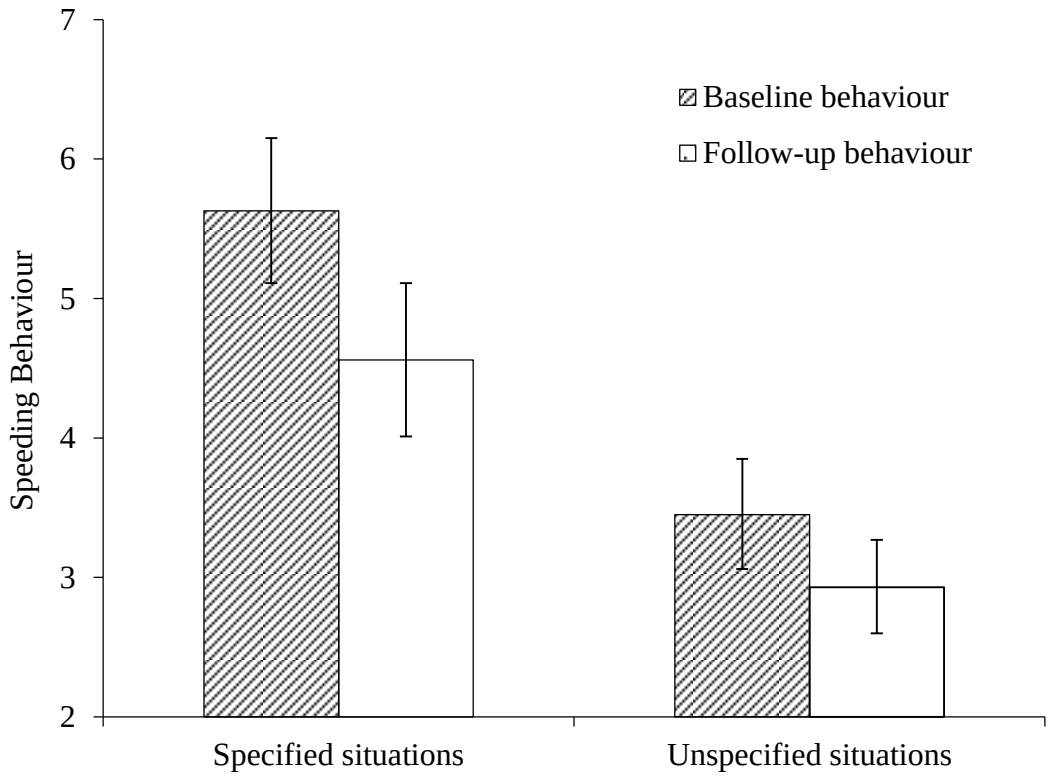

Figure 4.1. Speeding behaviour at baseline and follow-up in specified versus unspecified situations (experimental participants only)

4.3.5. Moderating effects of implementation intentions

A moderated linear regression and follow-up simple slopes analyses (Aiken and West, 1991) were conducted to test whether past speeding behaviour was a weaker predictor of subsequently reported speeding behaviour for the experimental participants than it was for the control participants (hypothesis 3). It was also tested, in the same analyses, whether goal intentions were stronger predictors of subsequently reported speeding behaviour for the experimental participants than they were for the control participants (hypothesis 4). The dependent variable in the regression was the follow-up measure of speeding behaviour. The independent variables were the baseline measures of speeding behaviour and goal intention, condition (0 = control; 1 = experimental), and the two-way interactions between the baseline measures of speeding behaviour and goal intention, on the one hand, and condition, on the other. Following the standard procedure for testing interaction effects outlined by Aiken and West (1991), the continuous independent variables (i.e., baseline speeding behaviour and goal intention) were mean-centred before the interactions were computed in order to reduce the possible effects of multicollinearity.

As shown in Table 4.5, the regression model accounted for 74% of the variance. The standardized beta weights showed that the independent predictors of the follow-up measure of speeding behaviour were the baseline measure of speeding behaviour, condition and the two interactions. The

simple slopes analyses (Aiken and West, 1991) decomposing the baseline behaviour X condition interaction (figure 4.2) showed that the baseline measure of speeding behaviour significantly predicted the follow-up measure in both conditions. However, in support of hypothesis 3, it was a weaker predictor in the experimental condition (β = .40, p < .01) than it was in the control condition (β = .91, p < .001). In support of hypothesis 4, the simple slopes analyses decomposing the baseline goal intention X condition interaction (figure 4.3) showed that baseline goal intentions were significant predictors of subsequently reported speeding behaviour for the experimental group (β = .50, p < .001) but not the control group (β = -.08, *ns*).

Table 4.5. Moderated linear regression predicting follow-up behaviour from baseline goal intention, baseline behaviour, condition, condition X baseline goal intention and condition X baseline behaviour

Variable	R^2	F	β
Baseline Goal Intention	.74	60.01	-.08
Baseline Behaviour			.90**
Condition (0 = Control; 1 = Experimental)			-.19**
Condition X Goal Intention			.38*
Condition X Baseline Behaviour			-.36*

*p < .01. ** p < .001

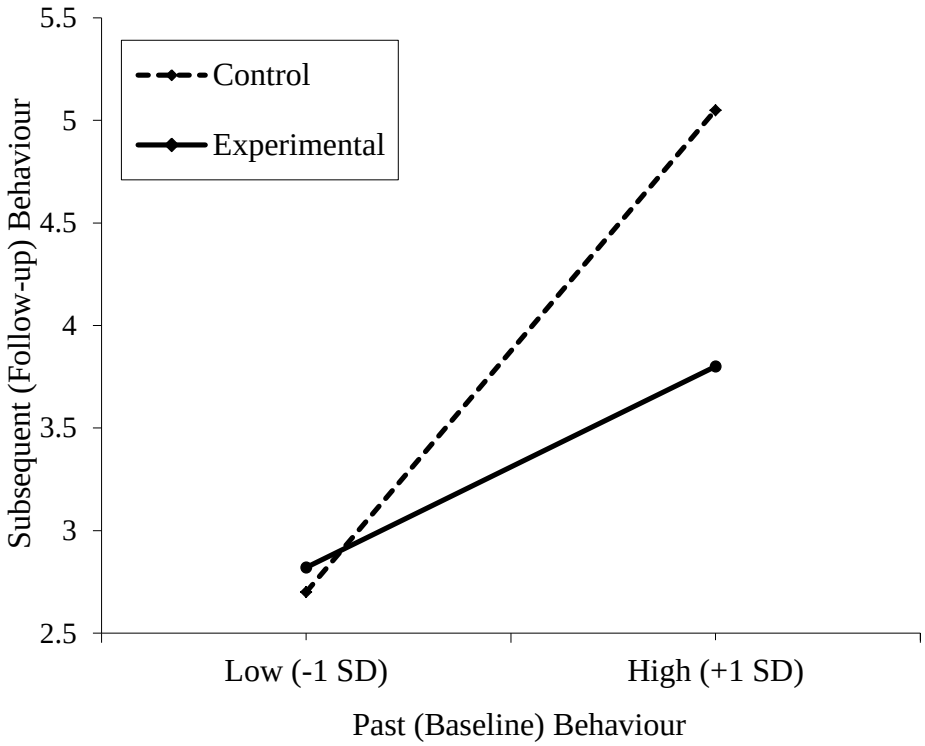

Figure 4.2. Simple slopes for the relationship between baseline behaviour and follow-up behaviour (for experimental and control participants, separately)

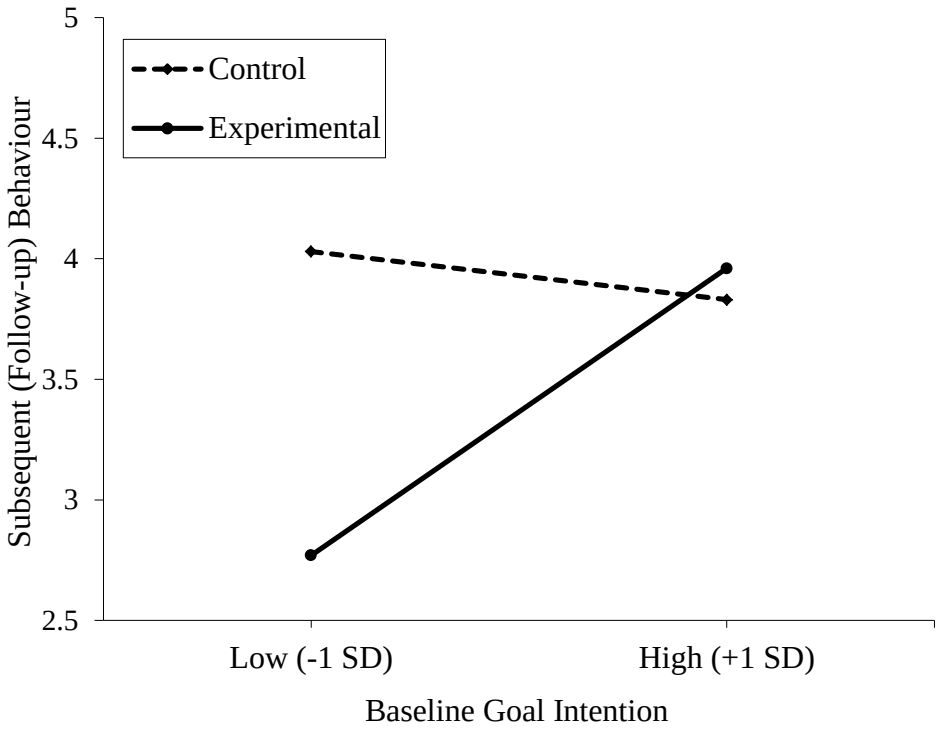

Figure 4.3. Simple slopes for the relationship between baseline goal intention and follow-up behaviour (for experimental and control participants, separately)

4.4 Discussion

This study was conducted to investigate the effects of implementation intentions on drivers' speeding behaviour. It was hypothesized that participants randomized to an experimental condition and asked to form implementation intentions, would report exceeding the speed limit less frequently at follow-up than would participants randomized to an active control condition (hypothesis 1). It was also hypothesized that this difference in subsequently reported speeding behaviour would be specific to inclined abstainers (hypothesis 2). Finally, it was hypothesized that past behaviour would be a weaker predictor of subsequently reported speeding for the experimental

participants than it would for the control participants (hypothesis 3) and that goal intentions would be stronger predictors of subsequently reported speeding for the experimental participants (hypothesis 4).

In support of hypothesis 1, the results showed that the experimental participants reported exceeding the speed limit significantly less often at follow-up than did the control participants, despite the two conditions reporting equivalent baseline levels of speeding behaviour and motivation to speed (i.e., goal intentions, attitudes, subjective norm and perceived control). The difference between the experimental and control participants in their subsequently reported speeding behaviour yielded an effect size estimate of $d = 0.39$. According to the conventionally accepted criteria in the social sciences for interpreting effect sizes (e.g., Cohen, 1992) this is approaching a moderate-sized change in behaviour. The findings are therefore consistent with studies of non-driving behaviours reviewed in chapter 3 in which implementation intentions have also been found to be an effective behaviour-change technique (Adriaanse et al., 2011; Belanger-Gravel et al., 2013; Gollwitzer and Sheeran, 2006). The findings are also consistent with Elliott and Armitage (2006), which is, to date, the only other study to have tested the effects of implementation intentions in the context of driving (also see chapter 3).

The findings also extend previous research on implementation intentions. First, in support of hypothesis 2, this study provides the first explicit demonstration that implementation intentions represent a useful behaviour-change strategy for inclined abstainers only. In line with theory (e.g., Gollwitzer, 1990), an interaction between

condition (experimental versus control) and suitability for intervention (inclined abstainers versus all other participants) was found in the follow-up measure of speeding behaviour. Decomposition of the interaction showed that the inclined abstainers in the experimental condition reported speeding significantly less often at follow-up than did the inclined abstainers in the control condition, with the difference between the conditions representing a large-sized reduction in speeding (*d* = 0.76). For the other participants, however, there was no difference between the conditions at follow-up, which explains why there was only a moderate-sized effect of implementation intentions when the full sample of participants (suitable for intervention [i.e., inclined abstainers] + unsuitable for intervention) was analysed. These findings therefore demonstrate that the effects of implementation intentions have been underestimated in previous studies in which researchers have sampled from general populations and not screened participants to ensure that they are inclined abstainers (e.g., Elliott and Armitage, 2006; Gollwitzer and Sheeran, 2006). Researchers should focus only on inclined abstainers in future tests of implementation intentions, unless of course a two-level approach is being used in which researchers aim to, first, motivate desirable behaviour (e.g., avoidance of speeding) in participants who do not declare as inclined abstainers, before using implementation intentions to help convert these participants' newly developed goal intentions into action (for an example of such a two-level approach in a non-driving context see Milne et al., 2002).

The second way in which this research represents an important contribution to the literature is that it adds to the currently small number of (non-driving) studies in

which implementation intentions have been tested using an active control condition (e.g., Armitage, 2008, 2015 Armitage and Arden, 2010, 2012; Conner and Higgins, 2010). Specifically, a demand was placed on the control participants in this study by giving standard (government) road safety educational information that is designed to change behaviour. This study therefore provides a more rigorous test of implementation intentions than most previous studies, in which researchers have used passive control conditions (e.g., Armitage, 2004; Elliott and Armitage, 2006; Sheeran and Orbell, 2000). The effects observed in this study are not therefore likely to be attributable to a demand effect.

The third way in which this study represents an important contribution to the literature is that it gives rise to the first volitional help sheet (e.g., Armitage, 2008) for changing driver behaviour. Consistent with volitional help sheets that have been developed for other social behaviours (e.g., Armitage, 2015a; Armitage, 2015b; Armitage and Arden, 2010, 2012), the present volitional help sheet provided an effective tool for promoting well-specified implementation intentions that explicitly link evidence-based critical situations (in this case, situations in which drivers are known to regularly speed) with theoretically derived goal-directed responses (strategies for changing behaviour based on Prochaska et al.'s (1988) processes of behaviour-change). It therefore helps overcome the problems described in chapter 3 that are associated with asking participants to self-generate implementation intentions, such as non-compliance with planning instructions (e.g., Michie et al., 2004; Rutter et al., 2006; Skar et al., 2011) and the specification of trivial or overly general critical situations and goal-directed responses that are unlikely to change

behaviour (e.g., Elliott and Armitage, 2006). Also, given the volitional help sheet contained 20 critical situations and 20 goal-directed responses from which the participants could specify their implementation intentions, it helps address the problems associated with traditional experimenter-provided implementation intentions (e.g., Parks-Stamm et al., 2007; Sheeran et al., 2005 [study 2]; Webb and Sheeran, 2004), which not only tend to be based on researchers' intuition but are also unable to account for between-person variation in exposure to different critical situations in real-world settings and between-person sensitivity to different behaviour-change techniques (also see chapter 3). More generally, the volitional help sheet developed in this research represents an effective intervention for reducing drivers' speeding behaviour (this issue is discussed in further depth in chapter 7).

The fourth way in which this study represents an important contribution is that it provides the first explicit test of the moderating effects of implementation intentions on the past – subsequent behaviour and the goal intention – subsequent behaviour relationships in the context of driving. In support of hypothesis 3, the baseline measure of speeding behaviour (i.e., past behaviour) was a weaker predictor of follow-up (i.e., subsequent) speeding behaviour for the participants in the experimental condition than it was for the participants in the control condition. In support of hypothesis 4, goal intentions as measured at baseline were stronger predictors of subsequently reported speeding behaviour for the participants in the experimental condition than they were for the participants in the control condition. These findings are consistent with previous research showing that implementation intentions moderate the effects of both past behaviour (e.g., Holland et al., 2006;

Orbell et al., 1997; Webb, Sheeran & Luszczynska, 2009) and goal intentions (e.g., Orbell et al., 1997; Sheeran & Orbell, 1999, 2000; Sheeran, Webb & Gollwitzer, 2005) on subsequent behaviour (see chapter 3). These findings support the idea that the strategic automaticity produced by implementation intentions can weaken the effects of habit (past behaviour) on speeding behaviour, allowing drivers to behave in accordance with their goal intentions.

Finally, the present study provided an initial test of the relative effects of implementation intentions on behaviour in specified and unspecified critical situations. More specifically, supplementary analyses showed that the experimental participants reported reduced levels of speeding behaviour over the study period in both the situations they specified in their implementation intentions and the situations they did not specify. However, speeding reduced to a significantly greater extent in the specified situations. These supplementary findings are consistent with the idea that implementation intentions initiate effective behaviour-change strategies (goal-directed responses) when specified critical situations are encountered (Gollwitzer, 1990). However, they are also consistent with the possibility that the behaviour-change effects of implementation intentions might generalize to other (unspecified) situations. This would have clear benefits from an intervention perspective because it would mean that implementation intentions are capable of producing wide-spread reductions in speeding, across large sections of the road network. It should be noted, however, that the present study was not designed to address this particular issue, and the supplementary findings are from a baseline to follow-up comparison of the experimental condition only (because control participants in this study did not

specify implementation intentions). The findings are nonetheless encouraging and the study reported in the next chapter was therefore carried out to provide a controlled test of whether the behaviour-change effects produced by implementation intentions can generalize from specified to unspecified critical situations.

Overall, the study reported in this chapter provides strong support for the efficacy of implementation intentions in the context of driving. However, the findings do need to be interpreted in light of the fact that a self-reported measure of speeding behaviour was used as the primary outcome variable against which the effectiveness of implementation intentions was judged. Self-reported behaviour measures are potentially vulnerable to a range of cognitive biases, such as the primacy and recency effect (Fulcher, 2003), self-presentational biases, such as self-deception and impression management (e.g., Paulhus, 2002) and affective biases, such as mood (Watkins, Vache, Verney, & Matthews, 1996). These biases can serve to inflate or deflate participants' estimates of how often they have engaged in a behaviour (e.g., speeding) over a study period (e.g., Corbett, 2001). Furthermore, self-reported behaviour measures are potentially vulnerable to demand effects in intervention studies such as this one (e.g., participants can report changing their behaviour simply because they have received an intervention).

There are, however, several reasons to be confident in the validity of the results. First, self-reported measures of speeding behaviour have previously been shown to correlate with objective measures of speeding in both driving simulator studies (e.g., Elliott et al., 2007; Helman & Reed, 2015) and on-road studies (e.g., Aberg, Larsen,

Glad & Beilinsson, 1997; Helman & Reed, 2015). Second, meta-analytic research shows that there is no difference between the size of the behaviour-change that is produced by implementation intentions when researchers use self-reported behaviour measures and the size of the behaviour-change that is produced by implementation intentions when they use objective behaviour measures (Gollwitzer and Sheeran, 2006). Third, as discussed earlier in this section of this chapter, an active control group was used in this study and it was still found that implementation intentions had a substantial effect on driver behaviour. Fourth, the behaviour-change observed in this study was not accompanied by a change in any of the other self-report measures (i.e., goal intention, attitude, subjective norm and perceived behavioural control). If the behaviour-change observed in this study were attributable to a general demand effect, changes in all or at least some of the other self-reported measures would have been expected. That said, despite these reasons to be confident in the findings, it would still be useful to replicate this study using more objective behaviour measures obtained from either instrumented vehicles (e.g., Lai and Carsten, 2012) or driving simulators (e.g., Elliott et al., 2007). This issue was therefore addressed in study 2, reported in the next chapter.

4.5 Conclusions

In conclusion, the research reported in this chapter provides evidence that specifying implementation intentions reduces drivers' speeding behaviour. It also shows that the effects of implementation intentions are specific to inclined abstainers, in line with theory (Gollwitzer, 1990; Orbell and Sheeran, 1998; Sheeran, 2002). The study also shows that the effects of implementation intentions on behaviour are volitional as

they were not attributable to any changes in drivers' goal intentions to speed or any other motivational construct. Implementation intentions were also found to moderate the relationships between past behaviour and goal intentions, on the one hand, and subsequently reported speeding behaviour, on the other, implying that implementation intentions weaken the effects of habit, thereby allowing goal intentions to be converted into action. Additionally, the volitional help sheet developed in this study provides a useful tool for helping drivers link evidence-based critical situations with theoretically derived goal-directed responses, and therefore form effective implementation intentions to reduce speeding.

Furthermore, this study provides some indicative evidence that implementation intentions reduce drivers' speeding behaviour in situations that are not specified in the IF component of the plan as well as in situations that are specified. This implies that implementation intentions do indeed initiate effective behaviour-change strategies (goal-directed responses) when specified critical situations are encountered (Gollwitzer, 1990) but also that the behaviour-change effects of implementation intentions might generalize to other situations. That said, these supplementary findings did not come from an analysis in which reductions in speeding behaviour in specified versus unspecified situations were compared with a control group. Also, the primary outcome measure used in this study was self-reported. The study reported in the next chapter was therefore designed to provide a more rigorous test of the possible generalization effects of implementation intentions. It was also designed to test the effect of implementation intentions on observed rather than self-reported speeding behaviour.

Chapter 5: Study 2: Testing whether the effects of implementation intentions generalise from specified to unspecified situations (exploring the IF component of implementation intentions)[4]

5.1 Introduction

The study reported in the previous chapter demonstrates that specifying implementation intentions is an effective strategy for reducing the extent to which drivers (inclined abstainers) report exceeding the speed limit. As discussed in the last chapter, however, there are several potential problems with self-reported measures of behaviour. More specifically, self-reports are vulnerable to a range of cognitive biases (e.g., primacy and recent effects), self-presentational biases (e.g., self-deception or impression management) and affective biases (e.g., mood). These biases can inflate or deflate participants' estimates of how often they have engaged in a behaviour (e.g., Corbett, 2001). In particular, self-reports are likely to be problematic measures of highly habitual behaviours such as speeding. This is because these behaviours tend to be performed automatically, with little conscious awareness (e.g., Bargh, 1994, 1996), meaning that people are likely to lack insight into the frequency with which they conduct them. Furthermore, self-reported behaviour measures are potentially vulnerable to demand effects in intervention studies because participants can readily report changing their behaviour simply because they are aware they have

[4] The research reported in this chapter has been published in the Journal of Experimental Psychology: Applied: Brewster, S. E., Elliott, M. A., McCartan, R., McGregor, B., & Kelly, S. W. (2016). Conditional or unconditional? The effects of implementation intentions on driver behavior. *Journal of Experimental Psychology: Applied*, *22*, 124-133.

received an intervention. While the research reported in the last chapter went some way to addressing some of these methodological problems (e.g., through the use of an active control group to alleviate experimenter demand), observations of behaviour are to be preferred to self-reports because they are less vulnerable to the above mentioned criticisms. The main aim of the research reported in this chapter was therefore to test the effects of implementation intentions on observed speeding behaviour.

The research reported in the previous chapter also provided indicative evidence that implementation intentions reduced drivers' speeding behaviour in situations they did not specify in the IF component of their plans in addition to the situations they did specify, albeit to a lesser extent. According to theory (e.g., Gollwitzer, 1990 and 1999; also see Webb & Sheeran, 2004; Webb & Sheeran, 2008 [study 2]), it is argued that implementation intentions exert *conditional effects* on behaviour. In other words, it is proposed that the initiation of the goal-directed response, which serves to change behaviour and is specified in the THEN component of the plan, is conditional upon the critical situation specified in the IF component being encountered (see chapter 3). While the previous study showed that reported speeding behaviour was found to reduce to a greater extent in specified situations than in unspecified situations, the finding that it did reduce in unspecified situations might illustrate that implementation intentions do not, in fact, exert conditional effects on behaviour. Instead, their effects on behaviour might be unconditional. In other words, it is possible that a goal-directed response can also be initiated by a critical situation that is not specified in the IF component of an implementation intention. However, the

research presented in the last chapter did not demonstrate reductions in speeding behaviour across specified versus unspecified situations in comparison to a control group. The research reported in this chapter was therefore designed to provide a controlled test of the potential unconditional effects of implementation intentions on observed speeding behaviour.

Previous research has not yet tested the potential unconditional effects of implementation intentions. Whilst previous field studies have shown that participants who specify implementation intentions are less likely to subsequently perform 'problem behaviours' (e.g., speeding) than are control participants (e.g., Andersson & Moss, 2011; Arden & Armitage, 2012; Armitage, 2004; Armitage, 2008; Conner & Higgins, 2010; Luszczynska, et al., 2007), the measures used in these studies aggregate behaviour across both specified and unspecified critical situations, meaning that any potential unconditional effects of implementation intentions cannot be identified. For example, in Elliott and Armitage's (2006) study on speeding, self-reported behaviour was measured in both the month before and after participants specified implementation intentions. As discussed in chapter 3, it was found that the participants who specified implementation intentions increased their compliance with speed limits over the study period in comparison with control drivers. However, these findings do not reveal anything about the specific situations in which compliance increased (i.e., whether it was only in the situations that participants specified in their implementation intentions or whether it was also in other situations).

It is acknowledged that previous laboratory experiments have tested the effects of implementation intentions in both specified and unspecified situations. For example, Webb and Sheeran (2007) gave participants an implementation intention to respond especially quickly to the non-word 'avenda' in subsequently presented word search puzzles ("If I see 'avenda', I will press the key especially quickly"). These participants were subsequently faster in responding to word search puzzles that contained 'avenda' than were the control participants, who simply familiarized themselves with this non-word by looking at it on a computer screen and repeating it under their breath for 30 seconds. Additionally, Webb and Sheeran (2007) found no difference between experimental and control participants in their response times to puzzles that contained words other than 'avenda'. These findings show, therefore, that participants enacted the required behaviour when they encountered the situation that they specified in the IF components of their implementation intentions but not when they encountered situations that they did not specify (also see Aarts, Dijksterhuis & Midden, 1999; Brandstatter et al., 2001; Parks-Stamm et al., 2007, study 1; Webb & Sheeran, 2004, 2008).

However, researchers have not previously manipulated the contextual similarity between the situations that participants specify in their implementation intentions and the situations they subsequently encounter in a study, meaning that the potential unconditional effects of implementation intentions have not yet been tested. For example, in Webb and Sheeran (2007), the finding that experimental and control participants did not differ in their response times to puzzles containing words other than 'avenda', might reflect the fact that the words in these puzzles contained

entirely different letter strings (e.g., ‘kaved’). Had words with letter strings similar to ‘avenda’ been used (e.g., ‘avenga’), then the experimental participants might have responded quicker than the control participants. Therefore, the question still arises as to whether implementation intentions generate behaviour-change when people encounter situations that are similar to the ones specified in the IF components of their plans.

In the study reported in this chapter, the aim was to provide a test of the conditional and unconditional effects of implementation intentions using a measure of observed rather than self-reported speeding behaviour. In line with previous laboratory research in other domains (e.g., Webb & Sheeran, 2007), it was hypothesized in this study that experimental participants would subsequently exceed the speed limit less frequently than would control participants when they encounter critical situations that are contextually identical to those specified in the IF components of their implementation intentions (hypothesis 1). It was also hypothesized that experimental participants would subsequently exceed the speed limit less frequently than would control participants when they encounter situations that are contextually similar to those specified in the IF components of their implementation intentions (hypothesis 2). However, no difference in speeding behaviour was expected between experimental and control participants when they encounter contextually different situations (hypothesis 3).

5.2 Method

5.2.1 Participants

The participants were *N* = 139 active drivers (UK driving license holders who drove at least once a week). They were recruited from a university campus in Glasgow, through advertisements on virtual learning environments and notice boards around campus, or from residential areas in the city, through advertisements sent to households. The mean age of the sample was 27.03 years old (*SD* = 13.21; range = 18 to 74 years) and 30% was male (*N* = 41)[5]. The mean weekly mileage was 90.64 (*SD* = 89.21; range = 5 to 500 miles) and the mean number of years licensed to drive was 8.71 (*SD* = 12.14; range = 1 month to 52 years).

5.2.2 Design and procedure

A randomized controlled design was used. Two hundred and twenty eight UK driving license holders initially volunteered to participate after being told that the study was a general purpose investigation into drivers' attitudes and speeding behaviour and that participation would involve the completion of one questionnaire, which would take approximately 15 minutes, and a simulator drive, which would last approximately 25 minutes. All 228 participants visited the Driving Research Laboratory within the University's School of Psychological Sciences and Health where they were tested

[5] Given that males comprise 54% of driving license holders in the UK, the ANOVA analyses presented in the main text (see table 5.2) were re-run with gender as an additional independent variable in order to ensure that the findings were not unduly influenced by an over-representation of females in the sample. There were no significant interactions between condition and gender in any analysis, meaning that the findings were the same for both male and female participants.

individually. Prior to arriving at the laboratory, the participants were randomized to one of three experimental conditions or a control condition using a random number generator. When they arrived at the laboratory, the participants in each condition completed a questionnaire that requested information about their demography (age, gender, weekly mileage, and number of years licensed to drive) and contained standard items that were used to derive baseline (pre-implementation intention manipulation) measures of speeding behaviour. Goal intentions to speed and the motivational pre-cursors of goal intention that are specified in the theory of planned behaviour (i.e., attitudes, subjective norms and perceived control; Ajzen, 1991) were also measured following the procedure adopted in study 1 (see chapter 4).

The questionnaires were identical across all conditions, except for the final page. The participants randomized to the experimental conditions were presented with a manipulation of implementation intentions on the final pages of their questionnaires. These participants were asked to specify implementation intentions to avoid speeding in three critical situations that were contextually identical, similar or different to those they would subsequently encounter on the driving simulator. In line with the gold standard procedure in intervention research (e.g., Armitage, 2008; Armitage & Arden, 2012), the participants randomized to the control condition were asked to read standard educational messages on the final pages of their questionnaires. This helped to guard against the potential effects of general experimenter demand (e.g., Rosenthal, 1966). Following the procedure

adopted in study 1, the control group messages warned participants about the risks of speeding and were taken from the UK Department for Transport's THINK! (national road safety education) Campaign (Department for Transport, *n.d.*).

After completing the questionnaires, follow-up (post-implementation intention manipulation) measures of speeding behaviour were obtained objectively from each participant using a driving simulator (see figure 5.1). The driving simulator was a STISIM Drive Model 400W. It was a fixed-based driving simulator with a three-screen, high resolution display, providing a 135 degree driver field-of-view. It had auditory and steering wheel feedback, and fully operational driving controls (steering wheel, brake, clutch, accelerator, gear stick, horn, speedometer, and tachometer). The rear view mirrors were displayed on the front and side screens. The simulator allowed driving speed to be measured in a controlled environment (i.e., where all participants are exposed to the same environmental stimuli), which would not be possible in the real world.

Figure 5.1 The driving simulator

All participants first drove through a 5 minute practice route, which served to familiarize them with the simulator and its controls. Before the practice drive, the participants were told that the simulator operated in the same way as a normal car and shown all the controls. The participants were also instructed to use all of the gears and test the brakes. After the practice drive, the participants drove through the trial route. The trial route comprised an urban distributor road with a 30mph speed limit. An urban traffic environment was selected because most traffic accidents occur on built up roads (Department for Transport, 2014b). The participants drove on the simulator for approximately 7.39 miles. Before driving on the trial route, all participants were informed that the speed limit was 30mph and were told to treat the simulation as if it were a real road, in the real world.

The simulated driving route included three critical situations, each of which is known to increase the likelihood of speeding (e.g., Stradling, 2005; Walker et al., 2009). In critical situation 1 ('driving whilst being followed closely/tailgated'), the participants drove along a straight section of road. No vehicles were modelled in the participants' carriageway to ensure that speed choices were unrestricted. A car approached the participants' 'vehicle' from behind and was visible in the rear view and side mirrors. The car remained approximately 0.5 seconds behind the participants' vehicle for a distance of 0.76 miles regardless of the speed at which the participants chose to drive. The participants' speeding behaviour was measured for the duration of the tailgating incident. In critical situation 2 ('driving after being stuck behind a slow moving vehicle'), the participants approached a vehicle travelling at 18mph along a straight section of road. A constant stream of oncoming traffic was modelled to ensure no overtaking opportunities. After 0.51 miles, the slow moving vehicle pulled into the side of the road. The participants' speeding behaviour was measured for the next 0.76 miles. In critical situation 3 ('driving whilst being overtaken'), a series of six vehicles overtook the participants whilst they drove along a straight section of road for approximately 0.38 miles. The vehicles were programmed to overtake regardless of the participants' travelling speeds. The participants' speeding behaviour was measured from the moment the first vehicle overtook until the moment the last vehicle finished overtaking. After driving on the simulator, the participants were fully debriefed and thanked for their time.

Recall from the research reported in chapter 4 that implementation intentions only reduce speeding for inclined abstainers, who, at baseline, reported exceeding the speed limit more than they intend to. Therefore, only those participants who reported speeding more than they intended to were included in the final sample in this study. The participants who reported speeding as much as, or less than, they intended (n = 89) were excluded from the final sample[6]. This left a final sample of N = 139 participants (n = 32 in the contextually identical condition; n = 34 in the contextually similar condition; n = 40 in the contextually different condition; n = 33 in the control condition). All of these participants completed the study in full.

5.2.3 The implementation intention manipulations

The participants randomized to the experimental conditions were asked to specify implementation intentions to reduce speeding using 'volitional help sheets' that were based on the one that was developed in study 1 (chapter 4). Recall that the volitional help sheet developed in study 1 provides participants with a list of 20 separate critical situations in which drivers are known to regularly exceed the speed limit (e.g., Stradling, 2005) and 20 goal-directed responses (strategies for avoiding speeding) that are theoretically derived from Prochaska and DiClemente's (1988) processes of behaviour-

[6] Consistent with the research reported in chapter 4, an ANOVA focusing only on the participants who were deemed unsuitable for inclusion in the final sample of this study confirmed that there was no difference between the conditions in subsequently measured speeding behaviour on the driving simulator, F (3, 85) = 0.64, *ns.* Also note that a chi-square test showed there was no difference between the conditions in the number of participants who were excluded from the final analysis χ^2 (3, N = 89) = 1.95, *ns*.

change. Each critical situation is presented as an IF statement (e.g., 'If I am tempted to speed when being overtaken by other vehicles…'). Each goal-directed response is presented as a THEN statement (e.g., '…Then I will drive in a lower gear to help me drive slower'). Also, recall that the participants' task is to form implementation intentions by selecting the critical situations in which they know they have the most difficulty complying with the speed limit and linking them with goal-directed responses that they believe will help them avoid the temptation to speed.

In the present study, the participants randomized to each experimental condition received a volitional help sheet that included three of the critical situations used in study 1. These participants were instructed to link each of the three critical situations with one of the 20 goal-directed responses. The participants randomized to the first experimental condition were given a volitional help sheet that included the three critical situations that were contextually identical to those modelled on the driving simulator. The participants randomized to the second experimental condition were given a volitional help sheet that included the three critical situations that were judged to be the most contextually similar to those modelled on the driving simulator. The participants randomized to the third experimental condition were given a volitional help sheet that included the three critical situations that were judged to be the most contextually different to those modelled on the driving simulator (see table 5.1 for a description of the critical situations used in each experimental condition).

Table 5.1. Critical situations specified in participants' implementation intentions by condition

Condition	Critical Situations (If I am tempted to speed…)
Contextually Identical	1. …when a driver behind me is putting on the pressure to drive faster by following too closely
	2. …after I have been stuck behind a slow moving vehicle
	3. …when being overtaken by other vehicles
Contextually Similar	1. …when a driver behind me is putting on the pressure to drive faster by flashing their lights/sounding their horn
	2. …after I have been stuck in stationary traffic
	3. … to keep up with traffic ahead
Contextually Different	1. …when traffic lights turn against me
	2. …when driving in heavy rain
	3. …when listening to certain types of music in the car

The critical situations from the volitional help sheet discussed in the previous chapter that were selected for use in the contextually similar and different conditions were chosen by two researchers (myself and my primary supervisor) who independently came to the same decisions about which ones were the most qualitatively similar and different to those used in the contextually identical condition. Qualitative assessments were used to decide which of the critical situations should be used in both the contextually similar and different conditions because the differences between the situations in

which people typically perform real-world behaviours, such as speeding, are not readily quantifiable. I return to this point in the discussion.

5.2.4 Measures

Baseline measures

Standard items, commonly used in previous research, were included in the questionnaires to measure baseline (pre-implementation intention specification) levels of speeding behaviour, goal intention, and the motivational pre-cursors that are specified by the theory of planned behaviour (e.g., Conner et al., 2007; Elliott et al., 2003 and 2013; Elliott, Armitage & Baughan, 2007). The participants were asked to respond to each item on a 9-point scale. Given that the participants in this study were required to drive on a simulator in addition to completing questionnaires, a single item measure of each construct was used to reduce the risk of participant fatigue (e.g., Hart, Rennison & Gibson, 2005). The following items were presented in a pseudo-random order within the questionnaire. The response scales for half the items were reversed in order to reduce the risk of response set biases (Coolican, 2014).

Speeding behaviour was measured by asking the participants to respond to the statement "I often drive faster than the speed limit" using a unipolar scale ranging from 'strongly disagree' (scored 1) to 'strongly agree' (scored 9). Goal intention to speed was measured by

asking participants to respond to the statement "I want to drive faster than the speed limit in my future driving", again using a unipolar scale that ranged from 'strongly disagree' (scored 1) to 'strongly agree' (scored 9). Attitude was measured by presenting participants with the item stem "For me, driving faster than the speed limit is…" Participants were asked to complete this sentence using a bipolar, semantic differential scale with the end points labelled 'extremely negative' (scored 1) and 'extremely positive' (scored 9). Subjective norm was measured by asking participants to respond to the following item "Most people who are important to me want me to drive faster than the speed limit". The participants responded to this item using a unipolar response scale with the end points labelled 'strongly disagree' (scored 1) and 'strongly agree' (scored 9). Finally, perceived control was measured by asking participants: "How much do factors outside your control influence whether or not you drive faster than the speed limit?" The participants responded to this item using a unipolar response scale with the end points labelled 'a lot' (scored 1) and 'not at all' (scored 9).

Follow-up measures

An objective measure of subsequent (post-implementation intention specification) speeding behaviour was obtained for each participant using data that was collected from the driving simulator. Speed in miles per hour was recorded every 5ft of the simulator drive. These

speed recordings were used to calculate the proportion of the distance that participants were travelling faster than 10% above the speed limit (i.e., faster than 33 mph) in the three critical situations. Speeding was defined as driving faster than 10% above the posted speed limit in line with UK police enforcement guidelines (see Stephenson, Wicks, Elliott & Thomson, 2010).

5.3 Results

5.3.1 Power Analysis

A power analysis was performed to ensure that the sample (N = 139) was sufficient to detect a meaningful sized effect. This analysis revealed that the power of the study to detect an effect size of $f^2 = 0.30$ at $\alpha = 0.05$ was .85. Given that this power was greater than 0.80, it was concluded that the present analyses had sufficient power to detect a meaningful sized effect (cf. Cohen, 1988, 1992).

5.3.2 Randomization checks

A series of ANOVAs was conducted to test whether there were any differences between the conditions on the baseline measures of behaviour, goal intention or the motivational pre-cursors of goal intention. The dependent variables were the baseline measures of behaviour, goal intention, attitude, subjective norm and perceived control. The independent variable in each analysis was condition. The analyses revealed no significant differences between the conditions on any of the baseline measures (see table 5.2). The

random allocation of the participants to the conditions was therefore deemed to be successful.

Table 5.2: Means, standard deviations and ANOVAs testing the differences between conditions on the measures

Variable	Condition							
	Contextually identical	Contextually similar	Contextually different	Control	Overall	ANOVA		
	M (SD)	*M* (SD)	*M* (SD)	*M* (SD)	*M* (SD)	*F*	MSE	*d*
	n = 32	*n* = 34	*n* = 40	*n* = 33	*N* = 139	(all *df*s = 3, 135)		
Baseline (pre- implementation intention/questionnaire) measures								
Speeding behavior	5.47[a] (2.60)	5.97[a] (2.46)	6.58[a] (1.75)	6.30[a] (2.35)	6.11 (2.30)	1.71	5.22	-0.12
Goal intention	3.34[a] (2.38)	3.59[a] (2.23)	3.95[a] (1.99)	3.45[a] (2.06)	3.60 (2.15)	0.72	4.60	0.11
Attitude	3.32[a] (2.01)	3.82[a] (2.04)	3.83[a] (1.71)	3.94[a] (2.01)	3.74 (1.93)	0.65	3.74	-0.14
Subjective norm	2.31[a] (1.97)	2.56[a] (2.20)	2.70[a] (2.34)	3.06[a] (2.50)	2.66 (2.26)	0.75	5.14	-0.25
Perceived control	5.00[a] (2.66)	5.06[a] (2.71)	4.93[a] (2.71)	4.67[a] (2.33)	4.91 (2.59)	0.13	6.81	0.12
Follow-up (post- implementation intention/driving simulator) measures								
Speeding behavior (% of the critical situations spent exceeding the speed limit on the driving simulator)	9.37[b] (17.13)	3.93[b] (9.21)	20.63[a] (29.07)	26.10[a] (30.90)	15.25 (24.95)	6.27*	558.61	-0.60

*$p < .001$. Mean scores across the conditions with different superscripts differ significantly.

5.3.3 Descriptive statistics

The sample means and standard deviations for both the baseline and follow-up measures are shown in table 5.2. The means on the baseline measures show that the participants, on average, reported exceeding the speed limit reasonably often (i.e., the mean score on the behaviour measure was around the scale mid-point, 5). However, they did not have strong goal intentions to speed and they reported having negative attitudes towards speeding, not feeling social pressure to speed and perceiving a moderate amount of control over their speeding behaviour. In line with the hypotheses, table 5.2 also shows that the participants in the contextually identical and contextually similar conditions exceeded the speed limit less frequently on the driving simulator than did the control participants (also see figure 5.2). However, the contextually different condition and the control condition displayed similar levels of speeding behaviour in the simulator.

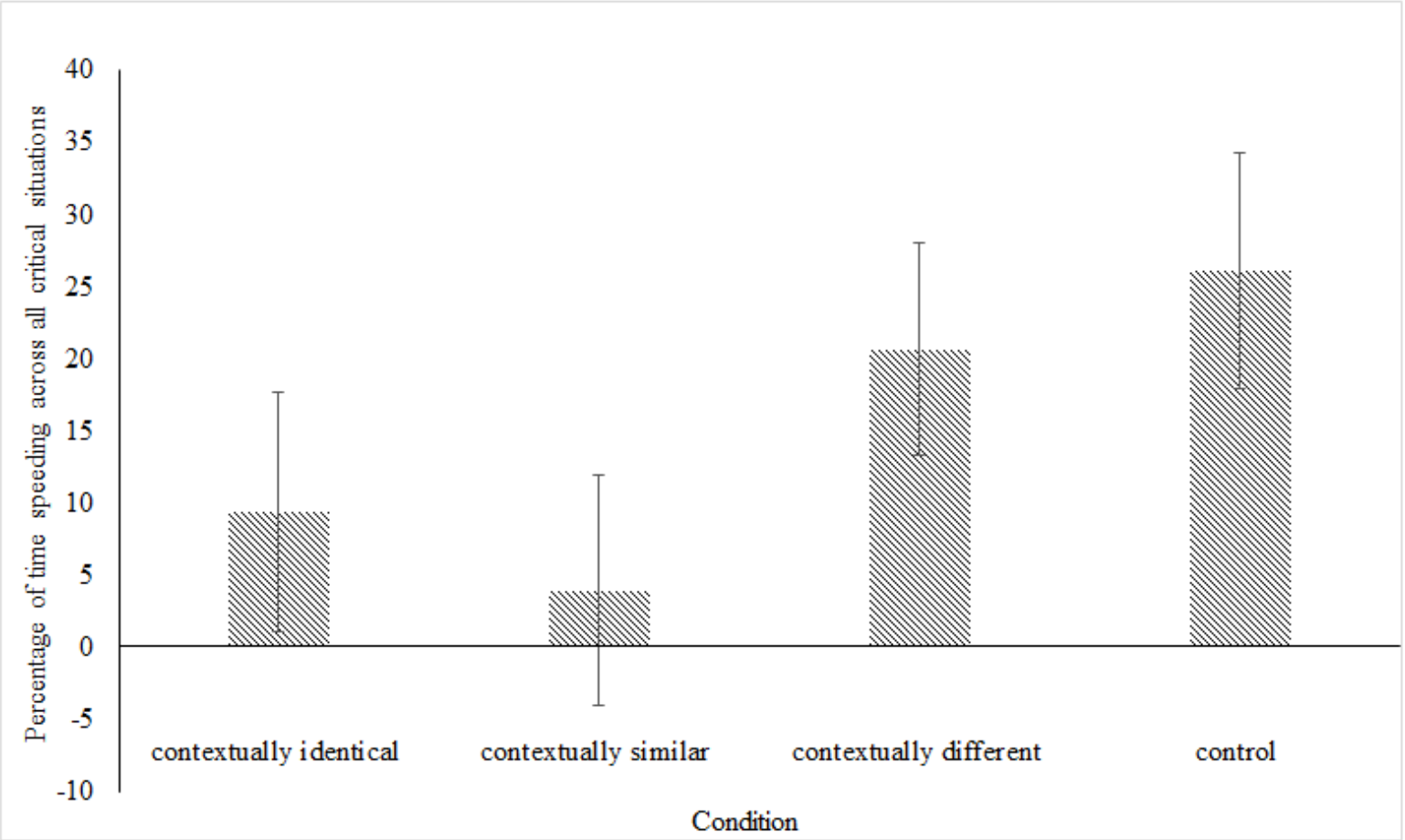

Figure 5.2. Speeding behaviour (means and 95% confidence intervals) in the critical situations by condition

5.3.4 Testing the conditional and unconditional effects of implementation intentions

A between-subjects ANOVA and Tukey post-hoc analyses were conducted to test the hypotheses. The dependent variable in the ANOVA was the follow-up measure of objective speeding behaviour from the driving simulator. The independent variable was condition. The ANOVA showed that there was a significant difference between the conditions on the measure of speeding behaviour (see table 5.2 and figure 5.2). In support of hypothesis 1, the Tukey post-hoc analyses showed that the participants in the contextually identical condition exceeded the speed limit less frequently on the driving simulator than did the control participants ($p < .05$, $d = -0.72$). In support of hypothesis 2, the participants in the contextually similar condition also exceeded the speed limit less frequently on the driving simulator than did the control participants ($p < .001$, $d = -0.95$). Also, as expected (hypothesis 3), there was no difference in speeding behaviour between the contextually different and

the control conditions (p = .76, d = -0.23)[7]. In addition, the difference in speeding behaviour between the participants in the contextually identical and similar conditions was not statistically significant (p = .79, d = 0.23).

5.4 Discussion

The aim of this study was to test the effects of implementation intentions on observed speeding behaviour. The study was also designed to provide the first controlled test of whether implementation intentions exert unconditional effects on behaviour. It was hypothesised that experimental participants would subsequently exceed the speed limit less frequently than would control participants when they encountered contextually identical situations to those specified in the IF components of their implementation intentions (hypothesis 1). It was also hypothesized that experimental participants would subsequently exceed the speed limit less frequently than would control participants when they encountered contextually similar

[7] While the control participants in this study were given educational messages to help control for general experimenter demand and an objective measure of speeding behaviour was used (see method section), it is possible that the hypothesized findings still reflect a specific demand characteristic whereby the participants in the contextually identical and similar conditions felt greater pressure to reduce their driving speeds than did the participants in the contextually different and control conditions when they encountered the critical situations on the driving simulator (i.e., because they recognized that they were driving in situations that were the same as or similar to those for which they had specified implementation intentions). I did, however, collect supplementary measures of perceived difficulty immediately after the participants completed the simulator drive. These are not reported in the main text because they were not required, in the end, to address the aims of this study. Nonetheless, the participants were asked to state how easy or difficult they found avoiding driving faster than the speed limit in each of the three critical situations on the simulator, using 9-point response scales (1 = very easy to comply with the speed limit; 9 = very difficult to comply with the speed limit). The mean of the three perceived difficulty items was taken and used as the dependent variable in an ANOVA, with condition as the independent variable. This analysis revealed no significant differences between the conditions, F (3, 135) = 2.04, *ns*. However, if the aforementioned demand characteristic was responsible for the results of this study, the observed differences in speeding behaviour that are reported in the main text would also be expected in the perceived difficulty measure, particularly since the perceived difficulty measure was self-reported and self-reports are more susceptible to demand characteristics than are objective measures (e.g., Paulhus, 2002). It is therefore difficult to attribute the findings reported in the main text to a demand effect.

situations to those specified in the IF components of their implementation intentions (hypothesis 2). However, no difference in speeding behaviour was expected between experimental and control participants in contextually different situations (hypothesis 3).

In support of hypothesis 1, it was found that participants who specified implementation intentions to avoid speeding in critical situations that were contextually identical to those they subsequently encountered on a driving simulator exceeded the speed limit less often, when they encountered those situations, than did the control participants. This difference was approaching a large-sized effect (d = -0.72). This finding is consistent with previous laboratory research (e.g., Aarts et al., 1999; Parks-Stamm et al. [2007; study 1]; Webb & Sheeran, 2004, 2007 and 2008) which has also shown that implementation intentions produce large-sized changes in behaviour when participants encounter the situations they specify in the IF components of their plans (Gollwitzer & Sheeran, 2006). It is also consistent with previous field research showing that implementation intentions have the capacity to bring about changes in real-world health behaviours generally (e.g., Andersson & Moss, 2011; Arden & Armitage, 2012; Armitage, 2004; Armitage, 2008; Conner & Higgins, 2010; Luszczynska et al., 2007). Within the context of this thesis, the findings are consistent with study 1, which also showed that implementation intentions can bring about large-sized reductions in drivers' speeding behaviour.

In support of hypothesis 2, however, it was demonstrated that participants who specified implementation intentions to avoid speeding in critical situations that were

contextually similar to those they subsequently encountered on the driving simulator also exceeded the speed limit less often than did the control participants. The results therefore extend the theoretical literature, and the findings from study 1, by showing that the effects of implementation intentions on behaviour are not entirely conditional upon people encountering the specific situations that are specified in the IF components of their plans. Instead, the results are consistent with the idea that implementation intentions have just as much capacity to change behaviour in situations that are contextually similar to those specified in the IF components of people's plans as they do in situations that are contextually identical. Additionally, in line with hypothesis 3, the results showed that there was no difference in subsequent speeding behaviour between the experimental participants who specified implementation intentions to avoid speeding in contextually different situations to those they encountered on the driving simulator and the control participants.

More generally, the lack of difference in subsequent behaviour between the contextually different and control conditions means it is unlikely that the observed reductions in speeding (i.e., in the contextually identical and contextually similar conditions) were attributable to a general demand effect, whereby specifying any kind of implementation intention is sufficient to change behaviour. It is also difficult to conclude that the findings were attributable to a specific demand experienced by the participants in the contextually identical and similar conditions when they encountered the critical situations on the driving simulator. This is because there were no differences between the conditions in post-simulator measures of perceived difficulty to avoid speeding in the specific situations that were tested in this study

(see footnote 7 on page 128). That said, it is possible that participants in the contextually similar condition did not perceive the situations they encountered to be different from those specified in the IF component of their plans. This could have potentially accounted for the finding that the contextually identical and contextually similar conditions did not differ from each other. Future research might therefore replicate this study and introduce a manipulation check to test whether the participants in the contextually similar condition do, in fact, distinguish between the specified situations and those that they subsequently encountered.

In addition to showing for the first time that implementation intentions can have unconditional effects on behaviour, this study extends the literature by showing that implementation intentions can change objectively measured speeding behaviour. This study therefore advances previous research by Elliott and Armitage (2006) and the research reported in chapter 4 of this thesis, in which implementation intentions have been shown to change self-reported measures of speeding behaviour, which are susceptible to cognitive (e.g., Fulcher, 2003), affective (e.g., Watkins et al., 1996) and self-presentational biases (e.g., Paulhus, 2002). On the basis of this study, it can be concluded with greater confidence that implementation intentions represent an effective strategy for reducing drivers' speeding behaviour.

While the study reported in this chapter demonstrates that implementation intentions can change objectively measured speeding behaviour, a driving simulator was used to collect the objective behaviour measures and driving simulators do not measure behaviour in the real-world. However, measures of speeding behaviour that are

derived from driving simulators have previously been shown to be good proxies for on-road speeding behaviour in the real-world (e.g., Conner et al., 2007; Elliott et al., 2007; Helman & Reed, 2015; Lockwood, 1997). In addition, driving simulators provide optimal experimental control. In this study, this means that the observed reductions in speeding behaviour can be attributed to implementation intentions rather than other confounding factors (e.g., road, weather and traffic conditions) that can influence real-world driving speeds. Finally, implementation intentions have been found to change objective measures of real-world behaviour in many field studies of other social behaviours (e.g., Holland et al., 2006; Luszczynska et al., 2007; Sheeran & Orbell, 2000). Overall, there is reason to be confident in the validity of the objective behaviour measure that was used in this study.

Another potential limitation with study 2 is that it did not provide any test of the *extent* to which critical situations need to be contextually similar (or different) to those specified in participants' implementation intentions before they initiate (or fail to initiate) the process of behaviour-change. As mentioned in the method section of this chapter, the contextual similarities and differences between the situations in which people typically perform real-world behaviours (e.g., speeding) tend to be inherently qualitative in nature and are therefore difficult to objectively quantify. As a result, this study tested the degree of behaviour-change that can be achieved in critical situations that myself and my primary supervisor independently deemed to be qualitatively similar and different to those specified in participants' implementation intentions. Traditional laboratory-based behaviours (e.g., performance on cognitive tasks) would provide greater opportunity to quantify the effects of contextual

similarity on the relationship between implementation intentions and behaviour-change. For instance, performance in a target detection task (e.g., requiring participants to detect an *N* sided shape) by participants who have specified prior implementation intentions to respond especially quickly when they see the target could be compared with the performance of participants who have specified prior implementation intentions to respond especially quickly when they see objects that incrementally differ from the target by a known constant (e.g., an *N*+1, *N*+2, or *N*+3 sided shape). A study of this kind would provide information about the number of contextual cues that a stimulus (critical situation) needs to share with the one specified in an implementation intention in order to initiate the specified goal-directed response (e.g., fast response latencies). That said, performance on cognitive tasks in laboratory settings has low ecological validity, which is clearly undesirable in applied studies such as this one.

5.5 Conclusions

To conclude, this study supports previous research in which implementation intentions have been shown to be a useful strategy for changing behaviour. More importantly, it extends previous research by showing that implementation intentions can change observed speeding behaviour and can produce unconditional effects on behaviour in so far as they change behaviour in situations that are similar, but not very different, to the ones that people specify in the IF components of their plans.

Chapter 6: Study 3: Testing the effects of different goal-directed responses on the efficacy of implementation intentions (exploring the 'THEN' component of implementation intentions)

6.1 Introduction

The study reported in the previous chapter of this thesis provided a controlled test of whether implementation intentions can change behaviour when people encounter contextually identical, similar and different situations to those specified in the IF components of their plans. It was found that implementation intentions can change behaviour (reduce speeding) when people encounter situations that are contextually identical and similar to those that they specify but not when they encounter situations that are contextually very different. Overall, study 2 was primarily concerned with testing theoretically derived hypotheses relating to the IF component of implementation intentions. In this third and final study of this thesis, the focus was switched to the THEN component of implementation intentions. More specifically, the aim of study 3 was to provide some insight into the most effective goal-directed responses for changing behaviour.

Recall that specifying an implementation intention requires people to specify a critical situation in which to perform an intended behaviour (IF component) and a goal-directed response that serves as a useful strategy for changing behaviour when that situation is encountered (THEN component). Also, recall that the first empirical

study reported in this thesis (see chapter 4) involved the development of a volitional help sheet (e.g., Armitage, 2008) for helping drivers to form effective implementation intentions to reduce their speeding behaviour. That volitional help sheet contained 20 specific critical situations in which it is common for drivers to speed or have difficulty complying with speed limits and 20 specific goal-directed responses that drivers can use for reducing their speeding behaviour. The 20 goal-directed responses were based on the 10 processes of behaviour-change outlined by Prochaska and DiClemente (1988) in their transtheoretical model: consciousness raising; self-reevaluation; self-liberation; counter-conditioning; stimulus control; reinforcement management; helping relationships; dramatic relief; environmental reevaluation; and social liberation. Each of these processes of behaviour-change gave rise to two specific goal–directed responses on the volitional help sheet.

Study 1 showed that the volitional help sheet was an effective tool for helping drivers form implementation intentions that reduced speeding behaviour. Drivers in study 1 were asked to choose up to four critical situations from the volitional help sheet in which they would try to reduce their speeding behaviour and to link each of their chosen critical situations with an appropriate goal-directed response. Participants who did this were less likely to speed one month later than were control participants who received standard road safety educational messages instead of the volitional help sheet.

Study 2 (see chapter 5) supported the findings from study 1. The participants in study 2 were asked to specify implementation intentions to reduce speeding in three pre-

specified critical situations that were either contextually identical, similar or very different to the ones they subsequently encountered on the driving simulator. They used a volitional help sheet to link each of the three critical situations with an appropriate goal-directed response. As in study 1, they were allowed to choose any of the 20 goal-directed responses from the volitional help sheet. It was found that participants who specified implementation intentions subsequently reduced their speeding behaviour in comparison to a control condition in which drivers received standard road safety educational messages instead of the volitional help sheet (so long as they encountered situations that were contextually identical or similar to those they had specified in their implementation intentions).

Studies 1 and 2 both showed, therefore, that forming implementation intentions by linking theoretically-derived goal-directed responses with critical situations is an effective strategy for reducing speeding. However, neither study 1 nor study 2 showed which theoretically-derived goal-directed responses comprise, on average, the most effective strategies for changing behaviour. This is because participants in both studies freely choose which goal-directed responses they wanted to use when specifying their implementation intentions. The study reported in this chapter was therefore a controlled experiment designed to test which of Prochaska and DiClemente's processes of change represent the most effective behaviour-change strategies for reducing speeding.

Armitage (2008) has previously attempted to identify which goal-directed responses are related to successful behaviour-change (quitting smoking). Armitage (2008)

coded whether his participants specified each of the goal-directed responses on his volitional help sheet or not and whether participants quit or continued smoking over the study period. It was found that participants who quit smoking were more likely to specify goal-directed responses relating to the dramatic relief process of change than were participants who continued to smoke. However, this was not a controlled test of which types of goal-directed responses are potentially most effective at changing behaviour and therefore the results could have been attributed to numerous other factors associated with the types of people who would be drawn towards dramatic relief strategies. A controlled test of which processes of change are most effective is therefore required.

A full controlled test of Prochaska and DiClemente's (1988) 10 processes of change would require an experiment with 11 conditions (i.e., 10 experimental conditions and a control condition). In each of the experimental conditions, participants would be required to specify implementation intentions to reduce speeding using the goal-directed responses relating to one of the processes of change. This would allow an assessment of the effectiveness of each behaviour-change process by comparing subsequent reductions in speeding behaviour in each experimental condition with the control condition. However, an experiment of that magnitude was not deemed feasible within this programme of PhD research given the scale of the studies reported in the previous two chapters and the sample size that would be needed to provide the required power. On the basis of the study reported in the last chapter, in which the sample of N=139 provided just enough power to conduct the statistical analyses (see section 5.3.1), a total sample of about N=700 drivers would have

needed to have been recruited. This would have returned approximately *N*=350 inclined abstainers (just over *N*=30 participants per condition who would have been suitable for inclusion in the study) using the procedure described in section 4.2.4 and employed in the previous two studies.

While it was not deemed feasible to provide a full test of Prochaska and DiClemente's (1988) 10 processes of change, it was deemed feasible to test two of the processes. The processes that were chosen for investigation were dramatic relief and counter-conditioning. Dramatic relief is defined as experiencing and expressing emotions about the consequences of the problem behaviour (e.g., thinking about the emotional pain that would be suffered if one were to cause a death or injury to someone due to speeding) and counter-conditioning is defined as substituting the problem behaviour (e.g., succumbing to the temptation to speed) with alternatives (e.g., ignoring the temptation or driving in a more careful and responsible manner). The rationale for choosing these two processes of change was principally based on the findings from the research already reported in this thesis, in which these two behaviour-change strategies were found to be the most frequently chosen by drivers when specifying implementation intentions to reduce speeding (see table 4.1). In other words, an examination of the effectiveness of the most frequently adopted speed-reducing strategies in studies 1 and 2 was deemed to be the most appropriate use of resources.

The decision to investigate dramatic relief and counter-conditioning, as opposed to any of Prochaska and DiClemente's (1998) other behaviour-change strategies, is also

supported by previous empirical research on driver behaviour, which suggests that these two behaviour-change techniques are likely to be particularly useful for reducing speeding. In particular, speeding is known to be dictated to a large extent by affective states. For instance, the literature on attitudes shows that there is an important distinction between instrumental (cognitive) attitudes (e.g., speeding is beneficial/worthless) and affective (emotional) attitudes (e.g., speeding is fun/dull) and affective attitudes are the stronger predictors of behaviour (e.g., Elliott & Thomson, 2010; Lawton, Conner & McEachan, 2009; Lawton, Conner & Parker, 2007). Additionally, affective constructs such as anticipated regret (the experience of a negative affective state following the realisation that the behaviour about to be performed is incorrect; Eagly & Chaiken, 1993) have been found to be more predictive of speeding intentions and behaviour than have other, more instrumental constructs (e.g., Elliott, 2012; Elliott & Thomson, 2010; Newnam, Watson & Murray, 2004). Therefore, goal-directed responses which tap into affective processes such as dramatic relief are likely to represent particularly effective behaviour-change techniques. Similarly, counter conditioning is about replacing the problem behaviour with alternatives and there is an abundance of research in the literature on learning theories showing that problem behaviours (e.g., speeding) tend to become extinct when individuals are conditioned to not perform them (Cannon, Baker, Gino & Nathan, 1986; Chapman, Smith & Layden, 1971; Morganstern, 1974).

To summarise, this study was conducted to test the extent to which goal-directed responses based upon the process of dramatic relief versus goal-directed responses based upon the process of counter-conditioning can reduce speeding. In line with

studies 1 and 2, it was hypothesised that experimental participants, both those who specify implementation intentions to avoid speeding using goal-directed responses based on dramatic relief and those who specify implementation intentions to avoid speeding using goal-directed responses based on counter-conditioning, would subsequently report speeding less frequently than would control participants (hypothesis 1). Given that affective constructs are known to better predict speeding than instrumental constructs it was also hypothesised that participants who specify implementation intentions using goal-directed responses based on dramatic relief (i.e., an affective behaviour-change process) would subsequently report speeding less frequently than would participants who specify implementation intentions using goal-directed responses based on counter-conditioning (hypothesis 2).

6.2 Method

6.2.1. Participants

All participants were active drivers (UK driving licence holders who drove at least once a week). Participants were recruited from: (a) a University in Glasgow, using advertisements placed on notice boards and virtual learning environments; (b) other UK universities, using a national postgraduate mailing list, (c) residential areas in the city, through advertisements sent to households. A total of 590 participants volunteered to take part in the study and 346 of them completed it (59% completion rate). The mean age of the sample was 35.86 years old (SD = 15.78; range = 18 – 80 years) and 28% was male (*n* = 97). The mean weekly mileage was 135.12 miles (SD =

156.95; range = 1 – 2000 miles) and the mean number of years licenced to drive was 15.46 years (SD = 14.18; range = 2 months – 56 years).

6.2.2. Design and procedure

Ethical approval for conducting this study was awarded by the ethical committee within the University's School of Psychological Sciences and Health. A randomised-controlled design was used. Participants were randomly allocated to either one of two experimental (implementation intention) conditions, or an active control condition. At baseline, all participants completed an online questionnaire. Note that self-reported measures of speeding were used in this study rather than observed measures of speeding because there were no differences in the findings between studies 1 (in which self-reported behaviour measures were used) and 2 (in which observed behaviour measures were used). Participants were told that the study was a general purpose investigation into drivers' attitudes towards speeding. Consistent with the previous two studies reported in this thesis, the baseline questionnaire measured basic demography (age, gender, weekly mileage and number of years licenced to drive), as well as speeding behaviour, goal intention to speed and the motivational pre-cursors of goal intentions specified in the theory of planned behaviour (attitudes, subjective norms, perceived control; Ajzen, 1991). These constructs were all measured using standard items that are commonly used in the social sciences (see Fishbein & Ajzen, 2010) and employed in studies 1 and 2.

On the final page of the baseline questionnaire, the participants randomised to experimental conditions 1 and 2 specified implementation intentions to avoid speeding using a volitional help sheet. Participants in experimental condition 1 (N = 110) specified implementation intentions to avoid speeding using goal-directed responses that tapped into the dramatic relief behaviour-change strategy. Participants in experimental condition 2 (N = 112) specified implementation intentions to avoid speeding using goal-directed responses that tapped into the counter-conditioning behaviour-change strategy. Consistent with studies 1 and 2, the control participants (N = 124) read educational information taken from the UK Department for Transport's THINK! campaign (Department for Transport, *n.d.*) about the risks of speeding generally, and government advice for how to drive safely.

One month later, all participants completed an online follow-up questionnaire, which contained identical items to the baseline questionnaire (i.e., items measuring speeding behaviour, goal-intention and the motivational pre-cursors of goal intention). Following the procedure for matching baseline and follow-up questionnaire that was employed in study 1, all participants were asked for their initials and first letter of their mother's maiden name on both questionnaires.

6.2.3. The implementation intention manipulations

Participants in the experimental conditions were asked to specify implementation intentions to avoid speeding using volitional help sheets (e.g.,

Armitage, 2008; Armitage & Arden, 2010, 2012; Armitage, 2015a; Armitage, 2015b). The volitional help sheets used in this study were based on the one used in study 1. Recall that the volitional help sheet comprised a list of 20 critical situations in which drivers might be tempted to speed and a list of 20 goal-directed responses (strategies) for avoiding speeding (see table 4.1 in chapter 4). Each of Prochaska and DiClemente's (1988) 10 processes of behaviour-change were tapped by two of the goal-directed responses. Each critical situation was presented as an IF statement (e.g., 'If I am tempted to speed when being overtaken by other vehicles…') and each goal-directed response was presented as a THEN statement (e.g., '…Then I will drive in a lower gear to help me drive slower'). Also recall that the participants' task was to form implementation intentions by selecting up to four critical situations in which they knew they had the most difficulty complying with the speed limit and linking each of them with a goal-directed response to help them to avoid the temptation to speed.

In the present study, the participants in both experimental conditions were asked to form implementation intentions using volitional help sheets that contained all 20 critical situations from study 1. Experimental conditions 1 and 2 differed only in the type of goal-directed responses that were contained in the volitional help sheets. The first experimental condition received a volitional help sheet containing the two goal-directed responses that mapped onto Prochaska and DiClemente's (1988) dramatic relief process of behaviour-change. These goal-directed responses were "THEN I will think

about the emotional pain I would suffer if my speeding caused a death or injury to someone" and "THEN I will remember how upsetting it is to see/hear about road traffic crashes caused by speeding motorists, and the distress caused to the victims and their families". The second experimental condition received a volitional help sheet containing the two goal-directed responses that mapped onto Prochaska and DiClemente's (1988) counter-conditioning process of behaviour-change. These goal-directed responses were: "THEN rather than speed, I will try to relax and drive in a more careful/considerate/responsible manner" and "THEN I will make a concerted effort to ignore the urge/pressure to speed".

6.2.4. Measures

Speeding behaviour and goal intention to speed

Following the procedure in study 1 (see chapter 4), speeding behaviour was measured at both baseline and follow-up by asking participants, "Over the last month, how often have you found yourself driving faster than the speed limit…?" Participants completed this item with regards to each of the 20 critical situations specified on the volitional help sheet, separately. A 9-point response scale ranging from 'never' (scored 1) to 'every time' (scored 9) was used. The mean of the 20 behaviour items produced a measure of speeding behaviour that possessed high internal reliability for the dramatic relief condition ($\alpha = .95$ at baseline and $\alpha = .96$ at follow-up), the counter-

conditioning condition (α = .94 at both baseline and follow-up) and the control condition (α = .94 at baseline and α = .95 at follow-up).

Goal intention was measured using 5 items: "I plan to drive faster than the speed limit over the next month" (1 = strongly disagree to 9 = strongly agree); "How likely or unlikely is it that you will drive faster than the speed limit over the next month" (1 = extremely unlikely to 9 = extremely likely); "I intend to drive faster than the speed limit over the next month" (1 = definitely no to 9 = definitely yes); "I would like to drive faster than the speed limit over the next month" (1 = strongly disagree to 9 = strongly agree); and "I want to drive faster than the speed limit over the next month" (1 = strongly disagree to 9 = strongly agree). The mean of these items produced the final measure of goal intention for the dramatic relief condition (α = .88 at baseline and α = .89 at follow-up), the counter-conditioning condition (α = .89 at baseline and α = .85 at follow-up) and the control condition (α = .87 at baseline and α = .90 at follow-up).

Following the procedure that was used in studies 1 and 2, only inclined abstainers were included in the final sample. As in studies 1 and 2, inclined abstainers (suitable for intervention) were identified on the basis of the final baseline measures of speeding behaviour and goal intention. N = 299 participants (n = 92 in the dramatic relief condition; n = 98 in the counter-conditioning condition; and n = 109

in the control condition) were classified as suitable for intervention (scored 1) because they reported speeding more than they intended to at baseline (i.e., their score on the baseline measure of behaviour was greater than their score on the baseline measure of goal intention). The remaining participants were classified as unsuitable for intervention (scored 0) because they reported speeding less often than they intended to or as much as they intended to at the outset of the study (i.e., their score on the baseline measure of behaviour was lower than or the same as their score on the baseline measure of goal intention).[8]

The motivational pre-cursors of goal intention

Attitude towards speeding was measured using 7 items. Participants completed the stem: "For me, driving faster than the speed limit over the next month would be…" using seven semantic differential scales: extremely unenjoyable (scored 1) to extremely enjoyable (scored 9); extremely worthless (scored 1) to extremely beneficial (scored 9); extremely bad (scored 1) to extremely good (scored 9); extremely negative (scored 1) to extremely positive (scored 9); extremely dull (scored 1) to extremely fun (scored 9); extremely unpleasant (scored 1) to extremely pleasant (scored 9); and extremely foolish (scored 1) to extremely wise (scored 9). The mean of these items produced the

[8] Consistent with the research reported in the previous two chapters, an ANOVA focusing only on the participants who were deemed unsuitable for inclusion in the final sample of this study confirmed that there was no difference between the conditions in subsequently measured speeding behaviour. That was the case for the overall measure of behaviour, F (3, 44) = 1.12, *ns*, and the measure of behaviour in participants' chosen situations, F (3, 44) = 1.50, *ns*.

final measure of attitude for the dramatic relief condition (α = .86 at baseline and α = .88 at follow-up), the counter-conditioning condition (α = .88 at baseline and .83 at follow-up) and the control condition (α = .84 at baseline and .87 at follow-up).

Subjective norm was measured using 2 items: "How often will the people who are important to you drive faster than the speed limit over the next month" (1 = never to 9 = very often); and "Of the people you know, how many do you think will drive faster than the speed limit over the next month" (1 = none of them to 9 = all of them). The mean of these two items produced the final measure of subjective norm for the dramatic relief condition (r = .66, p < .001 at baseline and r = .55, p < .001 at follow-up), the counter-conditioning condition (r = .45, p < .001 at baseline and r = .65, p < .001 at follow-up) and the control condition (r = .53, p < .001 at baseline and r = .66, p < .001 at follow-up).

Perceived behavioural control was measured using 7 items: "How confident are you that you will be able to avoid driving faster than the speed limit over the next month" (1 = not at all confident to 9 = extremely confident); "How much will factors outside your control influence whether or not you drive faster than the speed limit over the next month" (1 = a lot to 9 = not at all); "How much personal control do you feel that you have over whether or not you will drive faster

than the speed limit over the next month" (1 = no control at all to 9 = complete control); "I believe that I have the ability to avoid driving faster than the speed limit over the next month" (1 = strongly disagree to 9 = strongly agree); "Whether or not I drive faster than the speed limit over the next month is under my control" (1 = strongly disagree to 9 = strongly agree); "To what extent do you see yourself as being capable of avoiding driving faster than the speed limit over the next month" (1 = not at all capable to 9 = very capable); and "For me, avoiding driving faster than the speed limit over the next month would be" (1 = extremely difficult to 9 = extremely easy). The mean of these items produced the final measure of perceived behavioural control for the dramatic relief condition (α = .83 at baseline and α = .80 at follow-up), the counter-conditioning condition (α = .78 at baseline and α = .79 at follow-up) and the control condition (α = .79 at baseline and α = .84 at follow-up).

6.3 Results

6.3.1 Power analysis

A power analysis was performed to ensure that the sample was sufficient to detect a meaningful sized effect. Power was calculated using *N*=299 because *N*=299 was the number of participants who were deemed suitable for intervention. The analysis revealed that the power of the study to detect an effect size of $f^2 = 0.30$ at α = 0.05 was 1.00. Given that this power was greater than 0.80, it was concluded that the present analyses had sufficient power to

detect a meaningful sized effect (cf. Cohen, 1988, 1992).

6.3.2. Tests of attrition and randomization

A series of ANOVAs was conducted to test whether there were any baseline differences between participants (inclined abstainers) who dropped out of the study at follow-up (n = 174) and those who completed it (n = 299). The dependent variables in this analysis were the baseline measures of behaviour, goal intention and the motivational precursors of goal intention (i.e., attitude, subjective norm and perceived behavioural control). The independent variable was attrition (0 = dropped out of the study at follow-up; 1 = completed the study). As shown in table 6.1, these analyses revealed no significant effects of attrition on any of the measures. Therefore, there were no baseline differences between those who dropped out of the study at follow-up and those who completed it.

Table 6.1: ANOVAs testing the effects of attrition (0 = dropped out at follow-up; 1 = completed both baseline and follow-up) on the baseline measures of behaviour, goal intention and the motivational pre-cursors of goal intention

Dependent Variable	*F*	*MSE*	*d*
Behaviour	1.14	2.68	0.09
Goal Intention	0.23	0.73	-0.05
Attitude	0.23	0.66	0.03
Subjective Norm	1.25	3.67	0.09
Perceived Control	0.02	0.79	0.01

*$p < .05$ All *df*s = 1, 471

A series of ANOVAs was also conducted to test whether participants had been successfully randomised to the conditions (see table 6.2). The dependent variables were again the baseline measures of behaviour, goal intention and the motivational precursors of goal intention. The independent variable was condition (0 = control; 1 = dramatic relief; 2 = counter-conditioning). As table 6.2 shows, the ANOVAs revealed no significant effects of condition on any of the baseline measures. Overall, therefore the randomisation of the participants to the conditions was successful.

Table 6.2: ANOVAs testing the effects of condition (0 = control; 1 = dramatic relief; 2 = counter-conditioning) on the baseline measures of behaviour, goal intention and the motivational pre-cursors of goal intention

Dependent Variable	*F*	*MSE*	*d*
Behaviour	0.61	2.41	-0.12
Goal Intention	0.37	3.95	-0.09
Attitude	1.96	2.19	-0.23
Subjective Norm	1.39	3.14	0.19
Perceived Control	0.40	2.22	0.11

*$p < .05$ All *df*s = 2, 296

6.3.3. Descriptive statistics

The means shown in table 6.3 show that participants were not, in general, highly motivated to exceed the speed limit. The sample means on the baseline and follow-up measures of both goal intention and attitude were below the scale mid-points in all conditions. This indicates that participants, on average, did not report strong intentions to speed or particularly positive attitudes toward speeding. The means on the measures of subjective norm were around the scale mid-points at both baseline and follow-up, indicating that participants perceived only moderate amounts of social pressure to exceed the speed limit. The baseline and follow-up means for perceived behavioural control were heading towards the top of the scale in all conditions, indicating

that participants reported that they could easily avoid driving faster than the speed limit. The mean score on the measure of speeding behaviour shows that participants, on average, reported low to moderate levels of speeding (i.e., the means were between the bottom and the middle of the scale in all conditions).

Table 6.3: Means (SDs) and ANOVAs testing the differences between the conditions on the final measure of speeding behaviour, goal intention and the motivational pre-cursors of goal intention

Variable	Time	*M* (*SD*)			ANOVA		
		Cont	Exp 1	Exp 2	*F*	*MSE*	*d*
		(*N* = 109)	(*N* = 92)	(*N* = 98)	(2, 296)		
Behaviour	Baseline	4.11 (1.46)	4.00 (1.62)	3.88 (1.54)	0.08	2.58	0.00
	Follow-up	3.74 (1.54)	3.70 (1.69)	3.79 (1.59)			
Goal Intention	Baseline	3.77 (1.91)	3.57 (1.99)	3.54 (2.05)	0.19	3.52	0.07
	Follow-up	3.45 (1.88)	3.59 (1.95)	3.53 (1.83)			
Attitude	Baseline	4.12 (1.47)	3.86 (1.42)	3.74 (1.53)	0.14	2.05	-0.02
	Follow-up	3.85 (1.46)	3.88 (1.49)	3.77 (1.32)			
Subjective Norm	Baseline	5.75 (1.68)	6.06 (1.84)	6.17 (1.75)	2.19	3.20	0.23
	Follow-up	5.53 (1.80)	5.82 (1.81)	6.04 (1.74)			
Perceived Control	Baseline	6.63 (1.37)	6.68 (1.64)	6.56 (1.45)	0.47	2.08	-0.12
	Follow-up	6.69 (1.47)	6.53 (1.38)	6.52 (1.43)			

*p<.05 cont = control condition; exp 1 = dramatic relief condition; exp 2 = counter conditioning condition

6.3.4. The effect of dramatic-relief and counter-conditioning processes of change on reported speeding behaviour

A between-subjects ANOVA was conducted to test the hypotheses: (1) that experimental participants, who specified implementation intentions, would subsequently report exceeding the speed limit less frequently than would control participants and (2) that participants who specify implementation intentions using goal-directed responses based on the dramatic relief process of change would report speeding less frequently at follow-up than would participants who specify implementation intentions using goal-directed responses based on the counter-conditioning process of change. The ANOVA simultaneously tested both hypotheses. The dependent variable in the ANOVA was the measure of speeding behaviour, at follow-up. The independent variable was condition (0 = control condition; 1 = dramatic relief condition; 2 = counter-conditioning condition). Neither hypothesis was supported since no significant differences were found between the conditions (see table 6.3).

Given that studies 1 and 2 both showed that behaviour-change occurs to a greater extent in situations that participants specify in their implementation intentions than in situations they do not, another ANOVA was conducted focusing on speeding behaviour exclusively in the critical situations that the participants specified in the their implementation intentions. The rationale was that the null result in the above ANOVA could have been due to

participants' speeding behaviour in the unspecified situations attenuating the effects of implementation intentions to such an extent that it provided no chance of finding a significant difference between the conditions on the overall measure of behaviour. A measure of speeding in just the specified critical situations was therefore produced by taking the mean of the behaviour items that corresponded to those critical situations that participants in the experimental conditions selected on their volitional help sheets. It was not possible to produce this measure exactly within the control condition because the control participants did not specify implementation intentions. Therefore, a corresponding measure of behaviour for the control condition was calculated by taking the mean of the behaviour items across the four critical situations in which the control participants reported speeding most frequently at baseline. The rationale for this decision was that the experimental participants were asked to form implementation intentions in up to four critical situations on the volitional help sheet in which they knew they had the most difficulty complying with the speed limit (see section 6.2.3). In line with the ANOVA reported above, the additional ANOVA with speeding behaviour in participants' specified critical situations as the dependent variable and condition as the independent variable also revealed a null result, F (2, 296) = 0.35, *ns*. Therefore, both hypotheses were rejected.

6.4 Discussion

The aim of study 3 was to test the extent to which goal-directed responses based upon Prochaska and DiClemente's (1988) processes of dramatic relief

and counter-conditioning can reduce drivers' speeding behaviour. In line with studies 1 and 2, it was hypothesised that experimental participants, both those who specify implementation intentions to avoid speeding using goal-directed responses based on dramatic relief and those who specify implementation intentions to avoid speeding using goal-directed responses based on counter-conditioning, would subsequently report speeding less frequently than would control participants (hypothesis 1). Given that affective constructs are known to better predict speeding than instrumental constructs (e.g., Conner et al., 2007; Elliott, 2012; Elliott & Thomson, 2010), it was also hypothesised that participants who specify implementation intentions using goal-directed responses based on dramatic relief (i.e., an affective behaviour-change process) would subsequently report speeding less frequently than would participants who specify implementation intentions using goal-directed responses based on counter-conditioning (hypothesis 2).

This study, unlike study 1 (chapter 4) and study 2 (chapter 5), did not find any significant effect of implementation intentions on drivers' speeding behaviour. There were no differences in subsequent speeding behaviour between participants who specified implementation intentions using dramatic relief goal-direct responses, participants who specified implementation intentions using counter-conditioning goal-direct responses and control participants who were given standard road safety educational messages about the risks of speeding. This null result was found when both a general, overall measure of speeding behaviour (speeding across 20 different critical

situations) and a more specific measure of speeding behaviour (speeding in just the situations that participants in the experimental conditions specified in their implementation intentions) were employed. Therefore, both of the hypotheses were rejected. Some potential explanations for the null results will be explored in this section.

A first potential reason why implementation intentions were not found to alter behaviour in this study might be that specifying implementation intentions is simply not an effective strategy for reducing drivers' speeding behaviour. However, as discussed in chapter 3, research evidence has demonstrated that implementation intentions are effective at changing behaviour in general (e.g., Adriaanse et al., 2011; Belanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006) and also speeding behaviour specifically (e.g., Elliott & Armitage, 2006). In addition, studies 1 and 2 reported in this thesis both provided strong support for the notion that implementation intentions can indeed help drivers' to convert their positive intentions to avoid speeding, into action. Therefore, it is highly unlikely that this is the reason for the null effect in this study.

A second potential reason why implementation intentions were not found to alter behaviour in this study might be that the two processes of behaviour-change that were investigated (dramatic relief and counter-conditioning) are not effective at changing behaviour. However, this explanation also seems unlikely given that these were the two most commonly chosen strategy types

in both previous studies reported in this thesis, in which implementation intentions were able to successfully change drivers' speeding behaviour.

A third possible reason why implementation intentions were not found to alter behaviour in this study is that the measures of behaviour were somehow not appropriate for testing the hypotheses, thereby preventing any effect of implementation intentions from being detected. However, the Cronbach's alpha values for the overall behaviour measure in this study showed that it was a reliable measure. This behaviour measure was also used in study 1 (reported in chapter 4), where it was found to be reliable and where implementation intentions were found to generate behaviour-change. The more specific measure of speeding behaviour that was employed in this study was also employed in study 1, when conducting supplementary analyses to provide an initial exploration of whether the effects of implementation intentions on speeding behaviour might generalise from specified to unspecified situations (see section 4.3.4). Given that this measure was found in study 1 to produce significant results in line with a potential generalisation effect (also reported in section 4.3.4), there is no reason to assume that this measure of behaviour when employed in the present study would lack reliability. Overall, it is difficult to conclude that the measures used in study 3 were problematic given the findings reported in the earlier chapters of this thesis.

A fourth possible reason why implementation intentions were not found to alter behaviour in this study might be that the sample size was not sufficient to detect significant effects. However, the sample used in this study (N = 299 with approximately 99 participants per condition on average) was larger than the sample used in the study reported in chapter 5 (N = 139 with approximately 34 participants in each condition on average), in which a significant effect of implementation intentions on driver behaviour was found. In addition, a power analysis for this study (section 6.3.1) showed that the sample size was sufficient for detecting a meaningful sized effect of implementation intentions.

The fifth potential reason why implementation intentions were not found to alter behaviour in this study could be that the sample composition was somehow not appropriate for testing implementation intentions. However, consistent with the previous two studies, the final sample comprised exclusively of participants who were deemed to be inclined abstainers (i.e., theoretically suitable for receiving an implementation intention intervention) on the basis that they reported at the outset of the study that they exceeded the speed limit more frequently than they intended to. As shown in the previous two studies, implementation intentions change-behaviour for these participants. Also, although the participants in this study form a completely new sample, they were recruited from the same sources as were the participants in studies 1 and 2 and the same recruitment methods were

employed. It is unlikely, therefore, that the findings are due to sampling problems (e.g., biases).

Finally, and perhaps the most plausible explanation for why implementation intentions were not found to alter behaviour in this study is that the participants did not specify enough plans. The participants in each experimental condition were restricted to just two goal-directed responses when specifying their implementation intentions to reduce speeding. Furthermore, both goal-directed responses were designed to tap into the same process of behaviour-change (either dramatic relief, in the first experimental condition, or counter-conditioning, in the second). Therefore, the participants essentially specified implementation intentions containing a total of just one theoretically-derived strategy for reducing their speeding behaviour, meaning that they did not have another pre-specified strategy to fall back on should it have failed to engender behaviour-change.

On reflection, there is also evidence in the literature that specifying just one implementation intention is likely to be insufficient for producing behaviour-change in real-world contexts, such as driving. For example, in Elliott and Armitage's (2006) study on driving that was reviewed earlier in this thesis (see chapter 3), it was found that drivers who increased their compliance with speed limits over the study period specified, on average, 2.25 goal-directed responses in their implementation intentions whereas drivers who failed to increase their compliance with speed limits specified just 1.66 goal-directed

responses, on average. Similarly, out-with the driving context, Wiedemann et al. (2012) found that fruit and vegetable intake increased with the number of implementation intentions that their participants specified, with participants who specified 4 or 5 implementation intentions increasing their fruit and vegetable consumption the most and participants who specified just one or two implementation intentions increasing their fruit and vegetable consumption the least.

On reflection, therefore, it is likely that asking drivers in the present study to specify just the dramatic relief or the counter-conditioning processes of behaviour-change did not, on its own, provide enough potential for implementation intentions to change behaviour. Given that dramatic relief and counter-conditioning were the most commonly chosen behaviour-change strategies by the participants in the previous two studies, it is likely that they are in fact effective at changing behaviour, but only when they are specified in conjunction with other goal-directed responses.

It might, therefore, be worthwhile for future experimental research to identify the number of implementation intentions that need to be specified before a reduction in speeding behaviour can be found. After this has been established it would be possible to investigate the effectiveness of different *combinations* of goal-directed responses. Some combinations of behaviour-change strategies might be more complimentary, and increase the likelihood of effective behaviour-change, than others. For instance, self reevaluation

(assessing how you think and feel about yourself with respect to the problem behaviour) and helping relationships (seeking social support for changing the problem behaviour) might be a particularly good combination given that the person would receive feedback regarding their temptation to exceed the speed limit from both oneself and other people in their life.

6.5 Conclusions

In conclusion, this study did not support the previous two studies that are reported in this thesis, both of which showed that implementation intentions are an effective technique for reducing drivers' speeding behaviour. While there are a number of possible reasons for the null result that was observed in this study, the most plausible reason seems to be that specifying implementation intentions that contain just one process of behaviour-change is insufficient for changing behaviour. It would be worthwhile for future experimental research to provide a controlled test of how many behaviour-change processes need to be specified before implementation intentions start to engender a reduction in speeding behaviour. Subsequently, different combinations of goal-directed responses could be tested to determine the most complementary strategies for reducing speeding using implementation intentions.

Chapter 7: General Discussion

This final chapter will summarise the research presented in this thesis and draw conclusions for theory (implementation intentions and behaviour-change) and practice (road safety). This chapter will also consider some important methodological points of detail that need taking into account when interpreting the data from this programme of research, as well as the implications for future research.

7.1 Summary of the rationale for the research programme

Chapters 1 to 3 provided the overall rationale for the research programme reported in this thesis. The first chapter illustrated that road traffic crashes have a detrimental effect on road safety, the economy, the environment and health and wellbeing. It showed that road safety is an issue of global and national importance as traffic crashes cause extremely large numbers of injuries and deaths each year (WHO, 2004, 2015; Department for Transport, 2014a). It was also shown that while traffic crashes occur on all types of roads there is a particular problem on built-up roads (Department for Transport, 2014b) and it was shown that car and van drivers account for, by far, the largest proportion of traffic crashes (Department for Transport, 2014c). As a result, the research that was conducted within this PhD focused on the behaviour of car/van drivers while driving in built-up areas.

Chapter 1 also summarised evidence showing that driving violations are important predictors of road traffic crashes and that, out of all the contributory factors to traffic crashes, speeding is the largest (Department for Transport, 2013a). Additionally,

evidence was reviewed showing that speeding has a negative effect on the economy. It was mentioned that speeding costs the UK and US economies billions of pounds each year, not only because it increases the number of traffic crashes on the roads (Clifford & Theobald, 2011; National Centre for Statistics and Analysis, 2009) but because it increases journey times and congestion on road networks that are typically operating at capacity (The Eddington Transport Study, 2006).

With regards to the detrimental effect of speeding on the environment, it was shown in chapter 1 that road transport is a major contributor to CO2 levels and produces other harmful emissions (WHO, 2011) and that vehicles travelling at high speeds experience higher engine load requirements and, as a result, release more of these pollutants (Barth & Boriboonsomsin, 2008). It was also mentioned that CO2 and other greenhouse gases can also contribute to the development of cardiovascular and respiratory diseases (WHO, 2011), thus having a negative effect on individuals' health and wellbeing.

With regards to the other effects of speeding on health and wellbeing, it was mentioned in chapter 1 that speeding can prevent individuals from adopting healthy travel behaviours (e.g., walking and cycling) because many groups of people are fearful of fast moving vehicles (e.g., Christie et al., 2010; Tranter, 2010; Ward, 1999). It was mentioned that some people who experience difficulty crossing roads as a result of speeding vehicles may also be prevented from accessing goods and services, thus adversely affecting their social lives within their community (Christie et al., 2010; Tranter, 2010; Ward, 1999). In addition, it was shown that children's

independent mobility is adversely affected when parents are concerned about the dangers of speeding vehicles (Tranter & Pawson, 2001). Furthermore, it was stated that noise pollution from fast moving vehicles could negatively affect health and wellbeing through sleep disturbance and an increase in stress and anxiety levels (Ward, 1999).

Chapter 1 also mentioned that speeding is a highly prevalent behaviour, despite the negative impact it has on road safety, the economy, the environment and health and wellbeing. It was shown that speeding is generally viewed as an acceptable behaviour (Walker et al., 2009) and that many drivers openly admit to speeding (RAC, 2014). It was also shown that large proportions of drivers exceed the speed limit on all types of road when observed measures of speeding behaviour in free flowing traffic conditions are used (Department for Transport, 2015).

Overall, it was shown in chapter 1 that speeding represents a serious societal problem. Therefore, the main types of interventions to reduce this aberrant driving behaviour were discussed. These were enforcement (e.g., speed cameras, road policing), road and vehicle engineering (e.g., roundabouts, speed limiters) and driver education (e.g., media campaigns that raise awareness of the risks of speeding). It was shown that enforcement and engineering can both be effective at reducing speeding behaviour. However, it was also shown that drivers can often go unpunished by the police for speeding (Stradling, 2003) and that the effects of both enforcement and road engineering tend to be limited to the times or locations on the road network where they operate (Champness et al., 2005; Elliott and Broughton,

2005). Similarly, with regards to vehicle engineering, it was mentioned that speed restricting devices such as speed limiters are not mandatory and that most drivers would choose not to use them (Varhelyi et al., 1998, 2001). On the other hand, it was argued in chapter 1 that educational interventions should have a wider influence on driver behaviour because they aim to motivate drivers' to comply with speed limits (e.g., by promoting attitudes and intentions to avoid speeding) rather than control speed through non-ubiquitous external constraints. However, it was demonstrated that the evidence for driver education is not very convincing because it shows that educational interventions have typically produced, at best, only small-to-moderate sized changes in attitudes, intentions and speeding behaviour (e.g., Elliott & Armitage, 2007, 2009; Hardeman et al., 2002; Parker et al., 1996; Stead et al., 2005).

It was concluded in chapter 1 that a possible reason why road safety education has been shown to have limited effects on drivers' speeding behaviour is that it relies on a possibly erroneous proposition that motivating drivers to change their behaviour (e.g., through changes in attitudes and intentions) is sufficient to evoke behaviour-change. Chapter 2 therefore focused on the role of motivation (e.g., attitudes and intentions) in drivers' speeding behaviour. It was shown that goal intention (an overall summary of a person's motivation to carry out a behaviour) is a central concept in many social cognition models such as the theory of reasoned action (Fishbein & Ajzen, 1975), the theory of planned behaviour (Ajzen, 1985), protection motivation theory (Rogers, 1983) and the prototype willingness model (Gibbons & Gerrard, 1995) and that research evidence supports the idea that goal intention is an important determinant of behaviour, both generally (Albarracin et al., 2001; Cooke &

French, 2008; McEachan et al, 2011; Milne et al., 2000; Sheppard et al., 1988; Todd et al., 2014) and in the driving domain specifically (Chen & Chen, 2011; Conner et al, 2007; Dinh & Kubota, 2013; Elliott, 2012; Elliott et al., 2003, 2007; Elliott & Thomson, 2010; Chaleshgar et al., 2013; Paris & van den Broucke, 2008). However, evidence was also reviewed in chapter 2 showing that there is a gap between motivation and behaviour (e.g., Conner et al., 2007; Dinh & Kubota, 2013; Elliott, 2012; Elliott et al., 2003, 2007; Elliott and Thomson, 2010; Paris & Van den Broucke, 2008). Specifically, it was shown that about half of the variance in speeding behaviour is typically unaccounted for by goal intentions, meaning that there are likely to be many drivers who speed despite having intentions to the contrary. Research into goal intention-behaviour discrepancies was therefore discussed (e.g., Elliott & Armitage, 2006; Orbell & Sheeran, 1998; Sheeran, 2002). This research showed that the gap between goal intention and behaviour is mainly attributable to inclined abstainers (individuals who intend to perform the required behaviour [i.e., avoid speeding] but abstain from doing so). In particular, the research on goal intention-behaviour discrepancies in the context of driving showed that just over half of regular speeders do not, in fact, have prior goal intentions to break the speed limit (Elliott & Armitage, 2006). It was concluded therefore that interventions to promote positive attitudes and intentions (i.e., to avoid speeding) are not likely to be very effective at reducing speeding for this substantial section of the driving population. Instead, interventions for this group of drivers need to help ensure that existing goal intentions (to avoid speeding) are successfully converted into safe driving behaviour (i.e., actual on-road compliance with speed limits).

Chapter 2 also covered a range of possible reasons why some drivers might often fail to enact their generally 'good' goal intentions. It was mentioned that drivers may not recognise appropriate opportunities to perform their intended behaviour when they arise, they may not know how to behave when those opportunities arise, they simply forget to perform the required behaviour, or they have conflicting goals that reduce the likelihood of performing the intended behaviour (Orbell et al., 1997; Sheeran et al., 2005). It was also concluded that a key reason for drivers not translating their positive goal intentions to avoid speeding into action is that speeding is performed habitually (i.e., it is a product of a 'situation-response' link, which is strengthened with each repetition of the behaviour; Skinner, 1938). It was argued that once the habit is established, speeding is a response that is initiated automatically when the situations (in which drivers normally speed) are subsequently encountered. Evidence to support the idea that speeding is habitual came from accumulated research showing that past behaviour is the strongest predictor of subsequent speeding behaviour (e.g., Chorlton et al., 2012; Connor & Armitage, 1998; Elliott et al, 2003; Elliott & Thomson, 2010; Pelsmacker & Janssens, 2007) and research showing that past behaviour attenuates the effects of motivational constructs on subsequent speeding behaviour (e.g., Elliott et al. 2003; Holland et al., 2006). Chapter 2 concluded that the challenge for road safety interventions is to break unwanted speeding habits, thereby helping drivers with desirable goal intentions (i.e., to avoid speeding) to behave in accordance with those intentions.

Chapter 3 therefore introduced the concept of implementation intentions (Gollwitzer, 1990). It was argued that these 'IF-THEN' plans have the potential to break speeding

habits and facilitate the translation of goal intentions to avoid speeding into action. It was mentioned that implementation intentions are relevant to the volitional stage of Heckhausen and Gollwitzer's (1987) model of action phases, where individuals need to implement their intended actions. Recall that in the 'IF' component of an implementation intention, individuals are required to specify a critical situation in which they will perform an intended behaviour. Also recall that in the 'THEN' component of an implementation intention, an individual is required to mentally associate the specified critical situation with an appropriate goal-directed response. It was mentioned that the process of specifying a critical situation serves to encode a representation of that situation to memory, which is then 'activated' when the situation is subsequently encountered, making it highly salient (e.g., Webb & Sheeran, 2004; Webb & Sheeran, 2008 [study 2]). It was also mentioned that the process of linking the specified critical situation with an appropriate goal-directed response serves to automatically initiate a suitable strategy for ensuring the performance of the intended behaviour when the mental representation of the specified critical situation has been activated. In other words, as stated in chapter 3, implementation intentions operate in a similar way to habits because their specification leads to situation (IF) – response (THEN) associations that subsequently control behaviour (Adriaanse et al., 2011; Holland et al., 2006). However, given that implementation intentions are specified with one's most recent goal intention in mind, it means that the automatic behaviour that they produce is strategic (i.e., consistent with people's current goal intentions). It was therefore argued that implementation intentions are likely to overcome the above stated reasons for why many people fail to enact their goal intentions. In particular, it was

argued that the strategic automaticity produced by implementation intentions has the potential to overcome the influence of habit, thereby helping drivers' behaviour fall in line with their goal intentions.

Chapter 3 also reviewed previous meta-analytic research on implementation intentions showing that they are an effective strategy for changing behaviour generally (Adriaanse et al., 2011; Belanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006). It was also shown that the effects of implementation intentions are not attributable to changes in motivation, consistent with the idea that implementation intentions are a volitional strategy that converts existing motivation into action (e.g., Sheeran & Orbell, 1999; Sheeran, Webb & Gollwitzer, 2005; Webb & Sheeran, 2008 [study 1]). Similarly, non-driving research was reviewed showing that implementation intentions weaken the effects of past behaviour (habit) and strengthen the effects of goal intentions on subsequent behaviour in line with the idea that specifying implementation intentions can break unwanted habits and help individuals to successfully implement their goal intentions (Orbell et al., 1997; Sheeran & Orbell, 1999, 2000; Sheeran, Webb & Gollwitzer, 2005).

It was also noted in chapter 3 that just one study has previously tested the effect of implementation intentions on driver behaviour. More specifically, it was noted that Elliott and Armitage (2006) found that implementation intentions were effective at helping drivers to comply with the speed limit. They also found, consistent with theory, that implementation intentions were only effective at changing behaviour when participants reported moderate or high levels of goal intention to avoid

speeding but not when they reported low levels of goal intention. However, despite these encouraging findings, it was noted that Elliott and Armitage (2006) did not provide any formal moderator tests of whether specifying an implementation intention attenuates the past-subsequent speeding behaviour relationship (i.e., whether implementation intentions weaken speeding habits) or augments the goal intention – subsequent behaviour relationship (i.e., whether implementation intentions help drivers to successfully implement goal intentions to avoid speeding). Additionally, a number of limitations with the evidence-base for implementation intentions were noted.

The first limitation with the evidence-base that was noted in chapter 3 was that researchers have not explicitly sampled inclined abstainers in previous tests of implementation intentions, despite the fact that inclined abstainers are the only people who are suitable to target with an implementation intention intervention (e.g., Gollwitzer & Sheeran, 2006; Orbell & Sheeran, 1998; Sheeran, 2002). It was mentioned that this is likely to have led to underestimates in the size of the effect that implementation intentions can have on behaviour-change.

Chapter 3 also stated that researchers have relied heavily on passive control groups when testing implementation intentions (i.e., control groups in which no demand is placed on participants to change their behaviour). It was therefore argued that the findings of most previous studies are potentially vulnerable to experimenter demand biases (Rosenthal, 1966). These may have accounted for the observed changes in behaviour rather than implementation intentions *per se*.

Also, it was stated in chapter 3 that previous research focusing on real-world problem behaviours such as speeding has required participants to self-generate implementation intentions, leading to poorly specified IF-THEN plans that are unlikely to change behaviour (e.g., Elliott & Armitage, 2006; Sniehotta, 2009). It was shown that experimenter-provided implementation intentions, which are typically employed in laboratory studies (e.g., Webb & Sheeran, 2004), are not without their problems either. In particular, they are usually based on researcher's intuition rather than theoretically-grounded principles of behaviour-change (Armitage, 2008). Additionally, experimenters typically provide participants with just one implementation intention (the same for all participants in the sample) and this does not take into account between-person variation in exposure to different critical situations in real-world contexts (e.g., Stradling, 2005; Walker et al., 2009) nor does it take into account that the same goal-directed response is unlikely to be suitable for all participants (e.g., Sadler-Smith and Smith, 2004). It was therefore concluded in chapter 3 that an approach whereby participants are provided with a range of evidence-based critical situations (e.g., where drivers are known to exceed the speed limit or report difficulties complying with the speed limit) and theoretically derived goal-directed responses (e.g., established processes of behaviour-change) would seem a desirable strategy for helping individuals form effective implementation intentions.

Accordingly, a volitional help sheet (Armitage, 2008) was proposed as a potentially suitable method for helping drivers form effective implementation intentions to avoid

speeding. Recall that a volitional help sheet comprises a single sheet of paper on which there is a list of critical situations in which an individual might be tempted to perform the unwanted behaviour (presented as IF statements; e.g., 'If I am tempted to speed when being overtaken by other vehicles') and a list of goal-directed responses that can be used to help resist the temptation (presented as THEN statements; e.g., 'Then I will drive in a lower gear to help me drive slower'). Participants are asked to form implementation intentions by selecting the critical situations which they know are likely to tempt them to perform the unwanted behaviour and link them with goal-directed responses that they believe will help them avoid the temptation. It was shown in Armitage's (2008) seminal study that participants who formed implementation intentions to quit smoking by using a volitional help sheet reported smoking significantly fewer cigarettes and being less nicotine dependent than did control participants. However, as mentioned in chapter 3, there were, prior to the research reported in this thesis, no previous studies of driver behaviour in which volitional help sheets have been used to help participants develop implementation intentions.

Overall, on the basis of the research reviewed in chapters 1 to 3, the principal aim of the research reported in this thesis was to test whether implementation intentions constitute a useful strategy for reducing drivers speeding behaviour. In doing so, the above cited limitations with the general evidence-base for implementation intentions were addressed.

7.2 Study 1

Chapter 4 presented the first study in this programme of PhD research. The purpose of study 1 was to test the effects of implementation intentions on drivers' speeding behaviour. The study was a randomised controlled experiment. Speeding behaviour, goal intentions to speed and the motivational constructs underpinning goal intentions that are specified by the theory of planned behaviour were measured using self-completion questionnaires at both baseline and, one month later, at follow-up. After completing the baseline questionnaires, the participants randomised to the experimental condition were asked to specify implementation intentions to avoid speeding using a volitional help sheet. The critical situations on the volitional help sheet were identified from the literature on driving. They were situations in which drivers are known to speed frequently or report difficulties complying with speed limits. The goal-directed responses were theoretically derived behaviour-change strategies from Prochaska and DiClemente's (1983) transtheoretical model. An active rather than a passive control condition was also used in this study. After completing the baseline questionnaires, a demand was placed on the control participants to change their behaviour by giving them a standard educational intervention, which included UK Government approved messages about the risks of speeding (from the Department for Transport's THINK! Road Safety Campaign). Furthermore, inclined abstainers (suitable for intervention with implementation intentions) were tested separately from all other participants (unsuitable for intervention). This provided the first test of the theoretical proposition that implementation intentions generate behaviour-change only when participants intend

to perform the required behaviour (e.g., the avoidance of speeding) but abstain from doing so. Finally, the moderating effects of implementation intentions on the past-subsequent speeding behaviour and the goal intention-subsequent speeding behaviour relationships were tested.

It was hypothesised in study 1 that the experimental participants would subsequently (i.e., post-implementation intention specification) report exceeding the speed limit less frequently than would the active control participants and that this experimental versus control group difference would be specific to inclined abstainers. It was also hypothesised that past speeding behaviour would be a weaker predictor of subsequent speeding for the experimental participants than it would for the control participants (consistent with the idea that implementation intention can weaken the effects of habit on subsequent speeding behaviour) and that goal intention to speed would be a stronger predictor of subsequent speeding for the experimental participants than it would for the control participants (consistent with the idea that implementation intentions can help to convert goal intentions into action).

In line with the hypotheses, it was found that the experimental participants reported exceeding the speed limit significantly less frequently at follow-up than did the active control participants. These findings were therefore consistent with previous research in both driving (Elliott & Armitage, 2006) and non-driving (e.g., Gollwitzer & Sheeran, 2006) contexts, which have also shown that asking participants to specify implementation intentions is an effective way to evoke behaviour-change. However, and also in line with the hypotheses, study 1 extended the literature by showing that

the effect of implementation intentions on subsequent behaviour was specific to the inclined abstainers (who comprised 45.3% of the sample). The difference between the experimental and control conditions in the measure of subsequent speeding behaviour represented a large-sized reduction in speeding when only the inclined abstainers were included in the analyses (d = 0.76). On the other hand, there was no detectable effect of implementation intentions when the other participants in the sample were analysed. It was concluded that the effects of implementation intentions have been underestimated in previous studies in which researchers have sampled from general populations and not screened participants to ensure that they are inclined abstainers (e.g., Elliott and Armitage, 2006; Gollwitzer and Sheeran, 2006). It was also recommended that researchers should focus only on inclined abstainers in future tests of implementation intentions.

Study 1 also showed that the effects of implementation intentions on subsequent speeding behaviour could not be attributed to any changes in goal intention or any other motivational constructs over the study period. On a related point, and also in line with the hypotheses, implementation intentions attenuated the effect of past behaviour (habit) on subsequent speeding behaviour and augmented the effect of goal intentions on subsequent speeding behaviour. These findings were therefore consistent with previous research in non-driving contexts showing that implementation intentions can weaken habits (Holland et al., 2006; Orbell et al., 1997) and strengthen the influence of goal intention on behaviour (Orbell et al., 1997; Sheeran & Orbell, 1999, 2000; Sheeran, Webb & Gollwitzer, 2005). More generally, these findings showed that specifying implementation intentions to avoid

speeding helped drivers to convert their goal intentions into action, consistent with the volitional stage of Heckhausen and Gollwitzer's (1987) model of action phases.

The data from study 1 also permitted a test of whether the experimental participants reduced their speeding behaviour in the situations they specified in the IF component of their implementation intentions and those they did not specify. A supplementary analysis was therefore conducted. Although this analysis was a straightforward comparison of speeding behaviour before and after the experimental participants specified implementation intentions (i.e., not a controlled comparison), it did show that speeding behaviour reduced in both specified and unspecified situations, albeit to a greater extent in specified situations. It was therefore possible to tentatively conclude that the effects of implementation intentions on behaviour-change might generalise from specified to unspecified situations. It was noted in chapter 4 that this is important in the present context because it implies that interventions promoting the development of implementation intentions might generate widespread reductions in speeding across the road network, not just in those situations that drivers specify in the IF components of their plans.

Overall, study 1 showed that implementation intentions were effective at reducing speeding behaviour. It also showed that the effects of implementation intentions are specific to inclined abstainers, in line with theory (Orbell and Sheeran, 1998; Sheeran, 2002). It also showed that a volitional help sheet was an effective way to encourage the development of implementation intentions. The finding that implementation intentions moderated the relationships between past behaviour and

goal intentions, on the one hand, and subsequently reported speeding behaviour, on the other, also supported the idea that implementation intentions can weaken the effects of habit, thereby allowing goal intentions to be converted into action. Additionally, study 1 provided some limited evidence that implementation intentions reduce drivers' speeding behaviour in unspecified situations as well as specified situations.

7.3 Study 2

The second study presented in this thesis (reported in chapter 5) aimed to test the effects of implementation intentions on observed speeding behaviour using a driving simulator. It was noted that self-reported measures of behaviour (as in study 1) are vulnerable to demand effects and a range of cognitive (e.g., Fulcher, 2003), affective (e.g., Watkins et al., 1996) and self-presentational biases (e.g., Paulhus, 2002). Additionally, it was explained that self-reports are likely to be problematic measures of highly habitual behaviours such as speeding because these behaviours tend to be performed automatically, with little conscious awareness (e.g., Bargh, 1994, 1996), meaning that people are likely to lack insight into the frequency with which they conduct them. It was therefore deemed important to test, for the first time, whether implementation intentions could reduce speeding behaviour when measured objectively under experimentally controlled conditions.

Study 2 also aimed to extend the finding from the supplementary analysis that was conducted as part of study 1, which implied that implementation intentions might generate behaviour-change, not only in situations that participants specify in the IF

component of their plans but also in situations that they do not specify. Study 2 provided a formal test of whether implementation intentions exert conditional effects on behaviour (i.e., change behaviour only in the situations that participants specify in the IF components of their plans) or unconditional effects (i.e., change behaviour in unspecified situations too). It was expected that implementation intentions would exert unconditional effects on behaviour in so far as they would generate behaviour-change in unspecified situations that were contextually similar to those that were specified.

As with study 1, study 2 was a randomised controlled experiment. The participants completed questionnaires measuring their speeding behaviour, goal intentions to speed and the motivational constructs underpinning goal intentions that are specified by the theory of planned behaviour. The experimental participants then specified implementation intentions to avoid speeding in critical situations that were either contextually identical, similar or different to those that all of the participants subsequently encountered on the driving simulator. Control participants received, in line with study 1, educational information about the risks of speeding. Subsequent speeding behaviour was then measured on the driving simulator.

It was hypothesized that the experimental participants would exceed the speed limit less frequently than would the control participants when they encountered the critical situations that were contextually identical to those that they specified in the IF components of their implementation intentions. It was also hypothesised that the experimental participants would subsequently exceed the speed limit less frequently

than would the control participants when they encountered the critical situations that were contextually similar to those specified in the IF components of their implementation intentions. However, no difference in speeding behaviour was expected between the experimental and control participants when they encountered contextually different situations to those specified in their implementation intentions.

As reported in chapter 5, the hypotheses were supported. The participants who encountered driving situations that were contextually identical to those specified in the IF component of their implementation intentions exceeded the speed limit significantly less frequently on the driving simulator than did the control participants. This difference was approaching a large-sized effect (d = -0.72). This finding was therefore consistent with the findings from previous laboratory research (e.g., Aarts et al., 1999; Parks-Stamm et al. [2007; study 1]; Webb & Sheeran, 2004, 2007 and 2008) in which implementation intentions have been shown to produce large-sized changes in behaviour when participants encounter the situations they specify in the IF components of their plans (Gollwitzer & Sheeran, 2006). This finding was also consistent with previous field research in which it has been shown that implementation intentions have the capacity to bring about changes in real-world behaviours both within the context of driving (e.g., Elliott & Armitage, 2006; Study 1 of this thesis) and out with it (e.g., Andersson & Moss, 2011; Arden & Armitage, 2012; Armitage, 2004; Armitage, 2008; Conner & Higgins, 2010; Luszczynska et al., 2007).

It was also reported in chapter 5 that the participants who encountered driving situations that were contextually similar to those they specified in their implementation intentions exceeded the speed limit significantly less frequently on the driving simulator than did the control participants. This difference represented a large-sized effect of implementation intentions (d = -0.95). Furthermore, there was no difference in speeding behaviour between the participants who encountered situations which were contextually different to those specified in their implementation intentions and the control participants. It was therefore concluded that the effects of implementation intentions on behaviour are not entirely conditional upon people encountering the specific situations that are specified in the IF components of their plans, meaning that implementation intentions effects do indeed generalise from specified situations to other (unspecified) situations. In other words, it was concluded that implementation intentions have just as much capacity to change behaviour in situations that are contextually similar to those specified in the IF components of people's plans as they do in situations that are contextually identical. It was also noted that the results of study 2 were in line with study 1 because implementation intentions changed behaviour in both specified and unspecified situations. However, it was also concluded in chapter 5 that the findings from study 2 extend previous research on driving (Elliott & Armitage, 2006), and study 1, by showing that implementation intentions can change observed speeding behaviour (i.e., in a driving simulator) in addition to self-reports of speeding.

7.4 Study 3

Chapter 6 presented the final study in this programme of PhD research. In study 3, the focus of the research was switched from the IF component (as in study 2) to the THEN component of implementation intentions. More specifically, the aim of study 3 was to provide a controlled test of the most effective types of goal-directed responses (processes of behaviour-change; Prochaska & DiClemente, 1988) for reducing speeding behaviour. It was explained that a full test of all 10 of Prochaska and DiClemente's (1988) processes of behaviour-change was not feasible within this programme of research. Therefore, the two most common processes that were specified by the participants in the previous two studies were chosen for investigation. These were dramatic relief (experiencing and expressing emotions about the consequences of the problem behaviour) and counter-conditioning (substituting the problem behaviour [e.g., succumbing to the temptation to speed] with alternatives). These two types of strategies were also identified as being potentially useful for changing drivers' speeding behaviour. Dramatic relief was deemed to be a potentially useful strategy for reducing speeding on the basis that affective (emotion-based) constructs are very strong predictors of this behaviour, more so than are instrumental (cognitive) constructs (e.g., Conner et al., 2007; Elliott, 2012; Elliott & Thomson, 2010). Counter-conditioning was deemed to be a potentially useful strategy for changing behaviour on the basis of research showing that problem behaviours become extinct when people are conditioned not to perform them (Cannon et al., 1986; Chapman et al., 1971; Morganstern, 1974).

As with studies 1 and 2, study 3 was a randomised controlled experiment. The participants completed self-report questionnaires measuring speeding behaviour, goal intentions to speed and the motivational pre-cursors of goal intentions specified by the theory of planned behaviour, at both baseline and, one month later, at follow-up. After completing the baseline questionnaires, the participants randomised to a first experimental condition were asked to specify implementation intentions to avoid speeding using a volitional help sheet with goal-directed responses based on Prochaska & DiClemente's dramatic relief process of change. The participants randomised to a second experimental condition were asked to specify implementation intentions to avoid speeding using a volitional help sheet with goal-directed responses based on the counter-conditioning process of change. The full range of 20 critical situations used in study 1 were made available to all experimental participants. The control participants were instead asked to read the educational messages about the risks of speeding, as in studies 1 and 2.

In line with the findings of studies 1 and 2, it was hypothesised in study 3 that the experimental participants would, after specifying implementation intentions, subsequently report speeding less frequently than would the control participants. Given that affective constructs better predict speeding than do instrumental constructs (e.g., Conner et al., 2007; Elliott, 2012; Elliott & Thomson, 2010) it was also hypothesised that the participants who specified implementation intentions using goal-directed responses based on dramatic relief (i.e., an affective behaviour-change process) would subsequently report speeding less frequently than would the

participants who specified implementation intentions using goal-directed responses based on counter-conditioning.

As reported in chapter 6, no significant effects of implementation intentions were found on subsequent speeding behaviour. The participants who specified implementation intentions using dramatic relief goal-direct responses, the participants who specified implementation intentions using counter-conditioning goal-direct responses and the control participants did not differ on any measure of subsequent speeding behaviour that was employed in study 3. Chapter 6 therefore explored several potential explanations for this null result. Implementation intentions not being an effective strategy for reducing speeding and methodological issues (including the measures, the sample size and the sample composition) were eliminated as possible explanations. It was concluded that the most plausible explanation for the null result was that the participants did not specify enough IF-THEN plans. Essentially, the experimental participants specified implementation intentions containing a total of just one strategy for reducing their speeding behaviour (either dramatic relief or counter conditioning), meaning that there was not another discrete type of strategy for participants to fall back on if the one given to them failed to engender behaviour-change. It was noted in chapter 6 that this explanation is in line with previous research which suggests that more than one implementation intention is needed to engender successful behaviour-change (e.g., Elliott & Armitage, 2006; Wiedemann et al., 2012). It was concluded in chapter 3 that further research could usefully explore the most effective *combinations* of goal-directed responses (processes of change) within implementation intentions.

Overall, study 3 did not show that implementation intentions were effective at reducing speeding. However, it was likely that participants in this study did not specify enough implementation intentions to engender behaviour-change, which was not the case in the previous two studies. Given the findings from the previous two studies, the programme of work, as a whole, has been highly supportive of the use of implementation intentions to modify driver behaviour.

7.5 Implications for road safety interventions

Overall, the findings from this programme of PhD work are highly supportive of the use of implementation intentions to change driver behaviour, with studies 1 and 2 together showing that it is possible to achieve large reductions in speeding, not only in situations that are specified in the IF component of the IF-THEN plans but in other (unspecified) situations too. In other words, implementation intentions appear to constitute a powerful technique for promoting widespread reductions in speeding. The findings therefore have important implications for road safety. In particular, interventions encouraging the formation of implementation intentions could be usefully incorporated into existing road safety countermeasures such as media campaigns (e.g., Stead et al., 2005) or driver rehabilitation courses (e.g., McKenna, 2003). These educational interventions are common in the UK and other countries. However, as described in chapter 2, the available evidence suggests that they typically have, at best, small-to-moderate effects on drivers' intentions and behaviour (Elliott & Armitage, 2007, 2009; Hardeman et al., 2002) and often they have been shown to have no effect at all on drivers' intentions or behaviour (Parker et al., 1996;

Stead et al., 2005). Behaviour-change techniques that have been demonstrated to produce substantial reductions in speeding, such as implementation intentions, are therefore worth incorporating into educational interventions to enhance their effectiveness. Also, because educational interventions aim to motivate the development of desirable goal intentions (e.g., McKenna, 2007; Stephenson et al., 2010), implementation intentions are likely to compliment them very well (i.e., if educational interventions can be made to successfully promote desirable goal intentions to avoid speeding, implementation intentions can then help ensure that those newly developed goal intentions are converted into safe road use).

Moreover, the volitional help sheet developed for the research presented in this thesis (and used in full in study 1 and in part in the other two studies to test theoretically derived hypotheses) provides a useful tool for helping drivers link evidence-based critical situations with theoretically derived goal-directed responses, and therefore form effective implementation intentions to reduce speeding. This volitional help sheet also constitutes an easy to administer and cost effective intervention. It is effectively, a self-administered intervention and, therefore, there is no need for a road safety professional to deliver it. Also, because the volitional help sheet is a single sheet of paper that is self-administered it is also something that can be easily incorporated into many educational interventions, such as driver rehabilitation courses, without impinging very much on time or monetary resources. Also recall from study 1 (chapter 4) that the volitional help sheet was administered to some participants as a paper and pencil based task and others as an online task and it was found to be just as effective at reducing speeding either way. This suggests that there

are multiple delivery mechanisms (e.g., postal and web delivery) that can be used to obtain maximum "reach".

One issue that may raise concern is that implementation intentions were found in this research to reduce speeding for inclined abstainers only (participants who exceeded the speed limit more often than they intended prior to receiving the implementation intention interventions). The concern might be that implementation intention interventions only constitute an effective means of changing behaviour for a sub-section of the driving population. However, it is a substantial sub-section of the population who are appropriate for this kind of intervention. As discussed in chapter 3, previous research on driving has shown that just over half of all regular speeders are not inclined to speed (Elliott & Armitage, 2006). Also, in this programme of research it was found that inclined abstainers comprised 45.3% of the overall sample in study 1, and 60.96% of the overall sample in study 2. Given that there are over 36 million driving license holders in Great Britain alone (Department for Transport, 2013b), implementation intentions have the potential to bring about reductions in speeding for potentially millions of drivers nationally, and many more across the globe.

7.6 Possible limitations of the research

Several methodological features of the studies reported in this thesis have already been considered in previous chapters and many of them have been addressed empirically in this programme of research. In study 1, the primary concern was that implementation intentions were tested using self-reported measures of behaviour.

However, in study 2, objective measures of behaviour were used and implementation intentions were still found to reduce speeding. Additionally, as discussed in chapter 5, while driving simulators do not provide on-road measures of speeding they have been found to produce measures of behaviour that correspond closely to on-road driving (e.g., Conner et al., 2007; Elliott et al., 2007; Helman & Reed, 2015; Lockwood, 1997). Furthermore, as also discussed in chapter 5, driving simulators provide optimal experimental control, meaning that the observed reductions in speeding behaviour in study 2 could be attributed to implementation intentions rather than other confounding factors (e.g., road, weather and traffic conditions) that can influence real-world driving speeds. It should also be borne in mind that the research reported in this thesis addressed several of the key methodological limitations with the evidence-base and therefore provided a more stringent test of implementation intentions than most previous studies. In particular, active control groups were used in each study, meaning that it is difficult to attribute the present findings to demand characteristics.

However, one methodological issue that is relevant to all studies conducted as part of this PhD programme and has not yet been considered is the relatively short time delays between the baseline and follow-up periods. The longest follow-up in this programme of research was one-month (in studies 1 and 3). This might be considered quite short and not long enough to establish that implementation intentions can generate long-term reductions in speeding. However, research has shown that behaviour-change that has persisted for 3–4 weeks (as in study 1), tends to continue long after this time. For instance, Armitage (2005) found that patterns of behaviour

that were established over a one-month period of time were not substantially different several months later. Also, several studies in non-driving contexts have shown that the effects of implementation intentions can last years (e.g., Conner and Higgins, 2010) and that the effects of implementation intentions actually increase in strength over time (e.g., Sheeran and Orbell, 1999). While further research might usefully test the effects of implementation intentions on drivers' speeding behaviour using longer follow-up periods than in the present research, I am, overall, highly confident in the validity of the findings reported in this thesis.

7.7 Final conclusions

Overall, this PhD research shows that implementation intentions are an effective behaviour-change technique. In the present context, they are a powerful strategy for reducing drivers' speeding behaviour (regardless of whether self-reported or observed measures of behaviour are used) and therefore, reducing the traffic crashes, casualties and other societal problems associated with this aberrant driving behaviour. Implementation intentions have been shown in this research to change behaviour by weakening the effect of habit on subsequent behaviour, thereby allowing subsequent behaviour (avoidance of speeding) to fall in line with existing goal intentions. The research presented in this thesis has also addressed several limitations with the evidence-base for implementation intentions by focusing on samples of inclined abstainers, using active control groups and providing participants with a volitional help sheet to help them to form good quality implementation intentions. The volitional help sheet developed in this programme of PhD research

could be usefully incorporated into existing road safety countermeasures to help achieve widespread reductions in speeding across the road network.

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Appendix A: Volitional Help Sheet

All drivers speed on occasion, even though they may not intend to. People tend to be more successful at complying with speed limits if they identify situations in which they are tempted to speed and strategies to overcome the temptation. We would like you to do this now using the sheet below. From the list on the left, select up to 4 "tempting situations" (choose the ones in which you know you have the most difficulty complying with speed limits). Then use the list of "strategies" on the right to decide what you will do to resist the temptation to speed when you find yourself in each situation. It is important that you make a link between the tempting situations and the strategies that you select: Draw a line to link each tempting situation that you choose (on the left) with a strategy (on the right). You may choose the same strategy or different strategies to deal with the tempting situations that you select.

'Tempting situations'	'Strategies'
If I am tempted to speed when being overtaken by other traffic/another vehicle…	…Then I will tell myself that I have the ability to comply with speed limits if I want to
If I am tempted to speed in order to keep up with surrounding traffic…	…Then I will think about the emotional pain I would suffer if my speeding caused a death or injury to someone
If I am tempted to speed when under pressure from another driver following close behind me…	…Then I will remind myself that speeding increases my fuel consumption, which is bad for the environment and costs me money
If I am tempted to speed when another driver is putting pressure on me to drive faster by flashing their headlights/sounding their horn…	…Then I will remember that there are people in my life who are supportive of me complying with speed limits
If I am tempted to speed after I have been 'stuck' in stationary traffic…	…Then I will make a concerted effort to ignore the urge/pressure to speed
If I am tempted to speed after I have been 'stuck' behind a slow moving vehicle…	…Then, rather than speed, I will try to relax and drive in a more careful/considerate/responsible manner
If I am tempted to speed when driving on quiet roads with little or no traffic…	…Then I will tell myself that society is becoming less accepting and tolerant of speeding
If I am tempted to speed in order to get through traffic lights that have started to turn against me…	…Then I will think about how disappointed I would be in myself if I drove faster than the speed limit
If I am tempted to speed when driving on roads that I think should have higher speed limits….	…Then I will remember that I have made a commitment to avoid speeding
If I am tempted to speed when I am listening to certain types of music in the car….	…Then I will remember how upsetting it is to see/hear about road traffic crashes caused by speeding motorists, and the distress caused to the victims and their families
If I am tempted to speed when I am on a long journey…	…Then I will remind myself that speeding increases my vehicle emissions, which pollute the environment
If I am tempted to speed when I am feeling stressed…	…Then I will seek advice from people in my life (e.g. more experienced or calm drivers) about how to avoid speeding in such situations in the future
If I am tempted to speed when passengers are encouraging me to drive faster (overtly or otherwise)….	…Then I will drive in a lower gear to help me drive slower
If I am tempted to speed when I feel the urge to show-off or assert myself…	…Then I will remind myself that drivers caught for speeding (e.g. by the police or safety cameras) face sanctions
If I am tempted to speed when I am late or in a hurry to get somewhere (e.g. work/university/an appointment/to meet friends)…	…Then I will remember that speeding contradicts the view I have of myself as a considerate person
If I am tempted to speed when driving on familiar roads…	…Then I will tell myself how skilful a driver I am to be able to control my vehicle within the speed limit
If I am tempted to speed when I feel that there is little chance of being caught for speeding…	…Then I will remind myself that I am not saving much time by speeding
If I am tempted to speed when I feel like the car 'wants' to go faster….	…Then I will try to avoid putting myself in that situation again in the future
If I am tempted to speed when driving past a school…	…Then I will remember to tell myself that I am a good driver if I do not speed
If I am tempted to speed when driving down a road with parked cars…	…Then I will tell myself that although it might be an easy and enjoyable thing to do, speeding is a harmful and dangerous habit

Appendix B: Statement defining my contribution to previously published work

As stated in footnote 1 on page 68, the study reported in chapter 4 has been published in Accident Analysis and Prevention. The full reference for this publication is:

Brewster, S.E., Elliott, M.A. & Kelly, S.W. (2015). Evidence that implementation intentions reduce drivers' speeding behaviour: Testing a new intervention to change driver behaviour, *Accident Analysis and Prevention, 74,* 229-242.

Also, as stated in footnote 4 on page 107, the study reported in chapter 5 has been published in the Journal of Experimental Psychology: Applied. The full reference for this publication is:

Brewster, S. E., Elliott, M. A., McCartan, R., McGregor, B., & Kelly, S. W. (2016). Conditional or Unconditional? The Effects of Implementation Intentions on Driver Behavior. *Journal of Experimental Psychology: Applied*, *22*, 124-133.

I am first author on both papers. In both cases, I was responsible for all aspects of study design, conceptualisation of the research, data collection, data analyses, interpretation of the results and reporting the research.