Using cognitive dissonance inducing interventions to change drivers' attitudes towards speeding and reduce speeding behaviour

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Doctor of Philosophy

2019

Author's Declaration

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.

Signed:

Date: 16/12/19

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Acknowledgements

Thank you to my first supervisor, Dr Mark Elliott, for his support and encouragement during my time at Strathclyde. Thank you for your time, guidance, and invaluable advice over the years. I enjoyed working with you and I would not be in the position I am today without you. I would also like to thank Dr Allan McGroarty for his role as my second supervisor, Dr Steve Kelly for his role as panel reviewer, and to Dr Stephen Butler for his role as panel chair.

I would like to thank the ESRC, who funded this research, and the students who contributed to data collection. I would also like to thank all of the people who volunteered to take part in my research. I really appreciate you giving up your time to take part in my studies, as this research would not have been possible without you.

I would not have been able to get through this PhD without my friends and family. Thank you to the friends I made during my time at Strathclyde for all the healthy distractions and advice over the years. Thank you to my fiancé Fraser, who has been understanding and has helped me stay motivated. I appreciate everything you do for me and I love you, always. Thank you to my family, especially my mum, dad, and brother, Andrew, who have supported me throughout my PhD journey. I love you all and I appreciate all you do for me more than I can say.

A special thank you to Rufus, who was there for me during the highs and lows of my PhD journey. I love you and miss you.

Abstract

This research investigated the effects of cognitive dissonance (Festinger, 1957) inducing interventions on drivers' attitudes and speeding behaviour. Chapter 1 discusses the applied context (road safety) and the negative impact of speeding. Chapter 2 discusses the attitude-behaviour relationship and emphasises the need for both attitude-change interventions (for drivers whose speeding is potentially dictated by their generally pro-speeding attitudes) and attitude-conversion interventions (for drivers who speed despite holding generally anti-speeding attitudes). Chapter 3 introduces the theory of cognitive dissonance and reviews associated research relating to attitude-change (induced compliance) and attitude-conversion (hypocrisy induction) interventions.

Chapter 4 presents study 1, which was conducted to pilot test measures for the subsequent studies and investigate the components of attitude that predict speeding on the basis that this would have a bearing on how best to develop cognitive dissonance-based interventions (e.g., which components should be targeted?).

Chapter 5 presents study 2, which tested an induced compliance intervention in a sample of drivers with pro-speeding attitudes. As expected, the intervention engendered cognitive dissonance and engendered a change in the components of attitudes that were found to be the biggest predictors of speeding in study 1 at both immediate and one-month post-intervention. It also reduced one-month post-intervention (self-reported) speeding. Although the intervention did not result in immediate post-intervention (objective) behaviour-change and the changes in

attitudes were not attributable to the changes in cognitive dissonance, the one-month post-intervention behaviour-change was attributable to attitude-change.

Chapter 6 presents study 3, which tested a hypocrisy induction intervention. As expected, the intervention was found to generate reductions in speeding behaviour, in a sample of regular speeders with anti-speeding (i.e., hypocritical) attitudes at both immediate post-intervention (objective behaviour) and one-month post-intervention (self-reported behaviour). However, the intervention was not found to generate changes in cognitive dissonance.

Chapter 7 discusses the implications of this research for theory and enhancing road safety. Avenues for future research are also discussed.

Chapter 1: Speeding: The Applied Context

1.1 Chapter Summary

This chapter describes the applied relevance of the work in this thesis. It provides an overview of the impact that speeding has on the economy, and health and wellbeing. This chapter also discusses the prevalence of speeding behaviour and current interventions designed to reduce speeding (i.e., enforcement, engineering, and educational) in order to understand why there is a need to develop attitude and behaviour change interventions to reduce speeding behaviour.

1.2 Introduction

This chapter will firstly outline the importance of road safety through a review of traffic crashes and casualties (section 1.3). The detrimental effects of driving violations (section 1.4) and, in particular, speeding on road safety (section 1.5), the economy (section 1.6) and health and well-being (section 1.7) will then be discussed. Next, the chapter will consider the prevalence of speeding in the UK (section 1.8) with the aim of demonstrating why this behaviour is an important social problem that is pertinent to address. Finally, current interventions that are used to reduce speeding (i.e., speed enforcement, vehicle and road engineering and educational interventions) will be reviewed in order to ascertain how effective they have been at reducing speeding behaviour (section 1.9).

1.3 Traffic crashes and casualties

Road safety is a global concern. World Health Organisation (WHO) data show that road traffic crashes are the cause of over 1.35 million deaths worldwide each year, and between 20 and 50 million individuals are estimated to be injured in road traffic crashes worldwide every year (WHO, 2018). The WHO also estimate that road traffic crashes will become the seventh leading cause of death worldwide by 2030 if no remedial action is taken (WHO, 2018).

The most recent statistics for Great Britain show that, in 2017, there were 129,982 road traffic accidents, which caused 1,793 deaths and 170,993 (killed, seriously or slightly injured) casualties overall (Department for Transport, 2018e). Although the total number of casualties in Great Britain in 2017 was 6% lower than the previous year, and there has been a general reduction in road traffic crashes over the last 5 years (see Figure 1.1), the absolute number of road traffic casualties remains high and translates into 5 people, on average, being killed and 468 people being injured each day on Britain’s roads (Department for Transport, 2018e). In addition, official statistics relating to the total number of casualties on Britain’s roads do not take into account the number of road traffic casualties that are not reported to the police. This means that official statistics are likely to underrepresent the actual number of casualties (Department for Transport, 2018e), further emphasising the need for remedial action to improve road safety within Great Britain in addition to other countries across the globe.

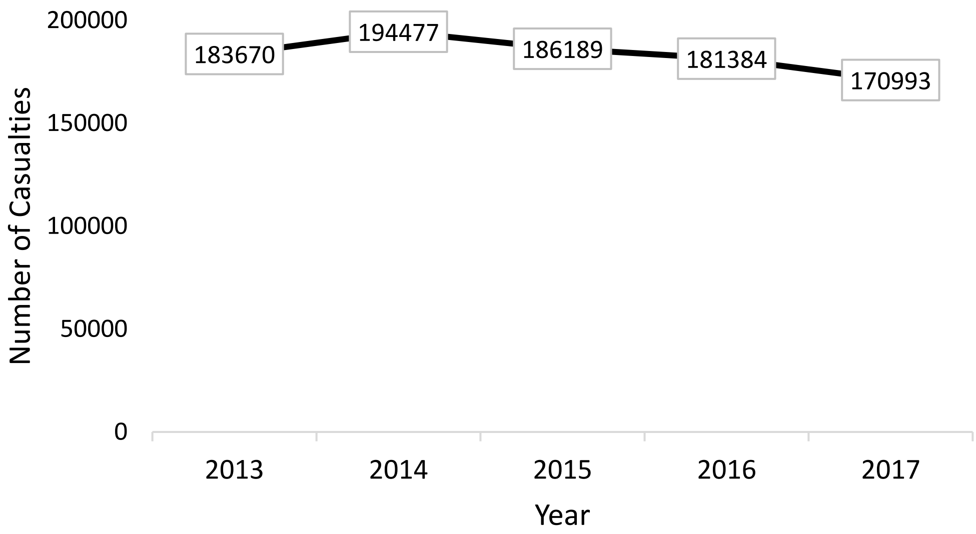

Figure 1.1: Reported road casualties in Great Britain from 2013-2017

Official data for Great Britain also show that road traffic crashes are a problem on all road types. In 2017, there were 626 fatalities and 107,347 casualties on urban roads; 1,068 fatalities and 55,876 casualties on rural roads; and 99 fatalities and 7,759 casualties on motorways (Department for Transport, 2018e). It is important, therefore, that interventions to reduce the number of road traffic crashes and associated casualties do so across all road types in Great Britain.

Road traffic crashes also involve a variety of different road users (e.g., car occupants, pedestrians, motorcyclists, pedal cyclists). The Department for Transport (2018e) reported that, in 2017, car occupants accounted for 44% (787) of all fatalities and 58.5% (100,082) of all casualties; pedestrians accounted for 26% (470) of all fatalities and 14% (23,805) of all casualties; riders of powered two-wheeled vehicles (e.g., motorcycles and mopeds) accounted for 19% (349) of all fatalities and 10.5% (18,042) of all casualties; pedal cyclists accounted for 6% (101) of all fatalities and 11% (18,321) of all causalities; and other road users (e.g., occupants of buses, coaches, vans, heavy goods vehicles) accounted for 5% (86) of all fatalities and 6% (10,743) of all casualties. While these statistics indicate that it is important to reduce the number of road traffic crashes and associated casualties for all road users, it is clear that the occupants of cars and other, non-two-wheeled motorised vehicles (buses, coaches, vans, heavy goods vehicles) account for the majority of road traffic casualties. In addition, substantial numbers of casualties within the other road user groups are caused through collisions with cars and other, non-two-wheeled motorised vehicles. For example, between 2009 and 2013, 82% of pedestrian casualties, 84% of riders of a motorcycle casualties and 87% of pedal cyclists' casualties resulted from a collision with a car (Department for Transport, 2015a, 2015b, 2015c). Thus, while interventions to reduce traffic crashes are needed for all road user groups, the largest improvements in road safety are likely to be gained by reducing traffic crashes involving the drivers of cars and other motorised, non-two-wheeled vehicles. An understanding of what causes road traffic crashes is therefore needed in order to understand how these reductions might be best achieved.

1.4. The detrimental effect of driving violations on road safety

Road safety research demonstrates that there are multiple causes of road traffic crashes (e.g., Department for Transport, 2018b; Rolison, Regev, Moutari, & Feeney, 2018). For example, factors external to the operators of motor vehicles such as poor weather conditions (e.g., rain, ice, snow), poor road conditions (e.g., potholes on the road) and vehicle factors (e.g., faulty instruments, brakes, tyres) can contribute to road traffic crashes as they can impact on traction, stability and manoeuvrability of a vehicle (e.g., Box & Bayliss, 2012). However, notwithstanding the contribution of these factors, it has been estimated that up to 85% of road traffic crashes are caused by aberrant driving behaviours, which are underpinned by drivers' faulty decision-making or skill deficits (e.g., Peden et al., 2004; Rumar, 1985).

Typically, road safety researchers and practitioners (Reason, Manstead, Stradling, Baxter, & Campbell, 1990) distinguish between three main types of aberrant driving behaviours: driving violations (deliberate departures from established rules or norms of what is safe behaviour on the road), mistakes (i.e., failures to execute planned safe driving behaviours as intended) and slips or lapses (i.e., unsafe driving behaviours that were not intended). Importantly, while mistakes and slips or lapses have been found to predict crash involvement (e.g., DeLucia, Bleckley, Meyer, & Bush, 2003; Department for Transport, 2014), research has demonstrated that driving violations are the main predictors (e.g., de Winter & Dodou, 2010; Parker, Reason, Manstead, & Stradling, 1995; Rowe, Roman, McKenna, Barker, & Poulter, 2015; Stradling, Parker, Lajunen, Meadows, & Xie, 1998). It is therefore important to identify the specific driving violations that contribute to road traffic crashes so that interventions can be targeted at those behaviours.

1.5 The detrimental effect of speeding behaviour on road safety

In the literature on road safety, many specific driving violations have been found to increase the risk of road traffic crashes. These include: mobile phone use while driving (e.g., Drews, Yazdani, Godfrey, Cooper, & Strayer, 2009; Olson & Fazio, 2009), tailgating (e.g., Murray, Lantz, & Keppler, 2006), poor lane discipline (e.g., Kusano & Gabler, 2015; Strandroth, 2015), disobeying give way signs, stop signs and other traffic signals or not stopping for pedestrians at crossings (e.g., Chen, Cooper, & Pinili, 1995), drink-driving (e.g., Keall, Frith, & Patterson, 2004; Zador, Krawchuk, & Voas, 2000; Zhao, Zhang, & Rong, 2014), drug-driving (e.g., Arria, Caldeira, Vincent, Garnier-Dykstra, & O'Grady, 2011; Brady & Li, 2013; Romano, Torres-Saavedra, Voas, & Lacey, 2014) and dangerous overtaking (e.g., D. D. Clarke, Ward, & Jones, 1998). Although other factors may feed into behaviours such as poor lane discipline (e.g., fatigue), these behaviours are often deliberative departures from the rules of what is safe on the road. Of all the driving violations that can contribute towards increased crash-risk, exceeding the speed limit (speeding) is one of the most consequential. Data that are routinely collected by the police on the driving violations that contribute toward road traffic casualties are summarised in Figure 1.2. As can be seen from the Figure, exceeding the speed limit is the greatest contributory factor, accounting for 203 fatal crashes in 2017 and 4,805 casualty crashes overall (fatal, serious and slight). Additionally, driving too fast for the conditions, which includes exceeding the speed limit, was a contributory factor in 136 fatal crashes and 5,946 crashes of all severities (see Figure 1.2).

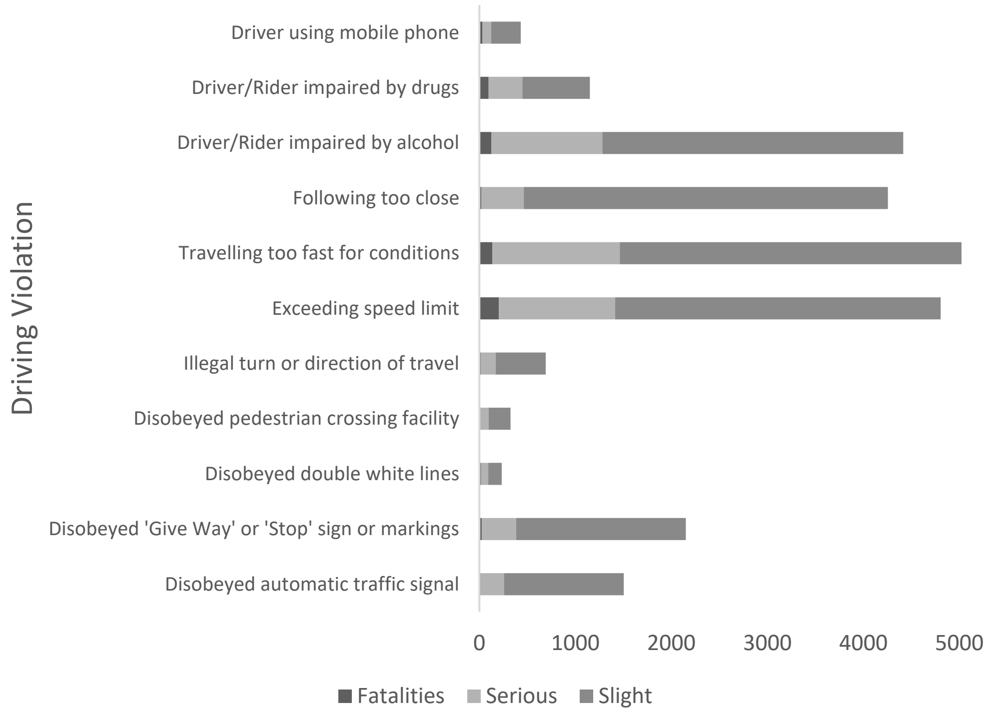

Figure 1.2: Driving violation contributory factors in road traffic crash fatalities and casualties (source: Department for Transport, 2018a)

In line with the contributory factors data in Figure 1.2, behavioural research in road safety has conclusively demonstrated that absolute driving speed (i.e., the speed of the vehicle) correlates positively with the number of traffic crashes. Increases in absolute driving speeds have been found to be associated with increases in the frequency of road traffic crashes regardless of whether self-reported or objective measures of driving speed or crash involvement are used in data analyses (e.g., Finch, Kompfner, Lockwood, & Maycock, 1994; Kloeden, McLean, Moore, & Ponte, 1997; V. M. Moore, Dolins, & Woodward, 1995; M. C. Taylor, Baruya, & Kennedy, 2002; M. C. Taylor, Lynam, & Baruya, 2000). From this research, it has been estimated that a 1mph increase in driving speed is associated with a 5% increase in traffic crashes, on average (Finch et al., 1994) and a 14% increase in fatal crashes (M. C. Taylor et al., 2002). Of course, absolute driving speed does not necessary mean driving in excess of the legal speed limit. However, the two are highly correlated (see Elliott, Armitage, & Baughan, 2007) and behavioural research in road safety has also demonstrated that exceeding the legal speed limit increases crash-risk. For example, Stradling (1999) found that drivers who had been caught for speeding by the police were 50% more likely to have been crash involved than were drivers who had not been caught (also see Campbell & Stradling, 2003; P. J. Cooper, 1997; Stradling, 2000, 2005; Williams, Kyrychenko, & Retting, 2006). Research has also shown that the frequency of road traffic crashes increases when legal speed limits are increased (e.g., Rock, 1995). Additionally, it has been estimated that just a 1% increase in the proportion of drivers exceeding the speed limit by 15mph across the road network leads to a 25% increase in the frequency of traffic crashes (e.g., M. C. Taylor et al., 2000). Although speeding increases the risk of accidents there are fewer casualties on motorways, as highlighted in section 1.3 (page 3) above, which have the highest speed limits. However, this may be explained by fewer potential hazards on a motorway compared to urban and country roads.

In summary, speeding increases the risk of road traffic crashes and out of all driving violations it is the one that contributes the most to both fatal and non-fatal traffic-crash casualties. Interventions that successfully reduce speeding can therefore be expected to reduce the number of road traffic crashes and the associated fatalities and non-fatal injuries that they produce.

1.6 The effect of speeding on the economy

As discussed in the previous subsection, speeding is a leading cause of traffic crashes. Consequently, this means that speeding has a detrimental effect on the UK economy. The total cost of all traffic crashes in the UK in 2017 was approximately £35 billion, which includes approximately £11.5 billion resulting from all reported injury accidents, approximately £4.5 billion resulting from damage only accidents, and approximately £19 billion resulting from non-fatal injury accidents not reported to the police (Department for Transport, 2018f). These figures take into account medical and ambulance costs, legal costs, insurance costs, police costs, costs relating to the damage to property and the costs associated with loss of income due to injury. It has also been estimated that the cost of speeding-related crashes, in the UK in 2017, was £1,897,129 per fatal-injury crash, £213,184 per serious-injury crash and £16,434 per slight-injury crash (Department for Transport, 2018a).

Speeding not only has a detrimental impact on the UK economy because of the costs associated with road traffic crashes, but it also has a detrimental effect on the economy because it reduces traffic flow (the total number of vehicles per hour passing through a given point of a road) once the flow capacity of a road (the maximum sustainable flow of traffic passing through a given point of a road in one hour) has been reached (e.g., Rees, Harbord, Dixon, & Abou-Rahme, 2004). More specifically, there is a hyperbolic relationship between driving speed, traffic flow and flow capacity. This means that traffic flow increases with driving speed until the flow capacity of a road has been reached. After that point, traffic flow decreases with increases in driving speed. Given the UK's road network is often at capacity (e.g., Rees et al., 2004), this equates to increased traffic congestion, which delays commutes and the delivery of goods and services and costs the UK economy £13.1 billion per year (Centre for Economics and Business Research, 2014).

In summary, speeding is a burden on the UK economy, due to the costs associated with road traffic crashes and congestion. Interventions that reduce speeding behaviour are therefore not only likely to be beneficial for reducing the number of road traffic crashes and casualties, but also the associated costs to the economy.

1.7 The effect of speeding on health and well-being

In addition to impacting on road safety and the economy, speeding also adversely impacts the health of the population. For example, speeding impacts on the environment as travelling at high speeds results in more greenhouse gas emissions (e.g., CO2; Barth & Boriboonsomsin, 2008). This, in turn, contributes to the development of cardiovascular and respiratory diseases (e.g., D'Amato, Cecchi, D'Amato, & Liccardi, 2010; Dockery & Stone, 2007). In addition, speeding can impact on individuals' decisions to make healthier transport choices. For example, walking and cycling are alternative modes of transport that are known to improve cardiovascular health and reduce the risk of heart disease, stroke and obesity (e.g., Hamer & Chida, 2008; Oja et al., 2011). Research has shown that a common reason why many people opt to drive a car rather than cycle or walk is because of the fear of fast-moving traffic and the dangers associated with this (e.g., N. Christie et al., 2011; Department for Transport, 2018h). The danger of fast-moving traffic is also commonly cited by parents as a reason for restricting their child's independent mobility, which is beneficial for health both in terms of immediate and longer-term development (Department for Transport, 2018d; Living Streets, 2008). In addition to the road safety and economic benefits discussed above (sections 1.5 and 1.6, respectively) improved physical health is therefore likely to be achieved from interventions that successfully reduce drivers' speeding behaviour.

1.8 Prevalence of speeding behaviour in the UK

Although speeding has a detrimental impact on road traffic crashes and casualties, the economy, and individuals' health and wellbeing, it is a highly prevalent behaviour. In Great Britain in 2017, over 2 million fixed penalty notices were issued for speed limit offences (Department for Transport, 2019; Scottish Government, 2018). Given that many drivers go unpunished for committing driving violations (e.g., Lawton, Parker, Manstead, & Stradling, 1997), the total number of drivers who commit a speeding offence is likely to be much higher than these figures suggest. Even self-report surveys, which are vulnerable to the under-reporting of driving violations (e.g., Corbett, 2001) have shown that around 40% of drivers admit to speeding on 20mph and 30mph urban roads, 35% admit to speeding on country roads and 60% admit to speeding on motorways (e.g., RAC, 2018). In addition, official statistics that provide objective data about free flow vehicle speeds in Great Britain (speeds that are not restricted by external factors such as junctions or speed enforcement cameras) show that 86% of cars travel at speeds in excess of the speed limit on 20 mph roads, 52% travel at speeds in excess of the speed limit on 30 mph roads, and 48% travel at speeds in excess of the speed limit on motorways (Department for Transport, 2018g). Furthermore, these figures have changed little over the past decade (Department for Transport, 2009, 2013a, 2018g).

Overall, the research evidence and official statistics together demonstrate that speeding is a highly prevalent behaviour, regardless of whether it is measured objectively, using direct observations of driving speeds, or subjectively, using self-report surveys. This demonstrates further the need for interventions that can reduce speeding and its adverse consequences on society.

1.9 Current interventions to reduce speeding

Given that speeding is a highly prevalent behaviour which has negative consequences for road safety, the economy, and health and well-being, interventions designed to reduce speeding have become commonplace. There are three main types of interventions that have been used to reduce speeding: enforcement (e.g., speed cameras); vehicle and road engineering (e.g., speed limiters and traffic calming techniques such as road humps); and education (e.g., media campaigns). The effectiveness of each of these types of interventions will be discussed in the following subsections.

1.9.1 Enforcement

Enforcement strategies for reducing speeding behaviour include physical policing (marked or unmarked officers stationed at the side of the road or policing sections of the road network) and automated policing (fixed or temporary speed cameras both of which can be traditional speed cameras, which measure driving speeds at one point in time at one location on the road, or average speed cameras, which measure mean driving speeds across a section of the road). Regardless of the specific strategy, however, enforcement is designed to motivate drivers to adhere to the speed limit in order to avoid being punished for speeding (i.e., through fines or penalty points on the driving licence).

Empirical reviews have demonstrated that enforcement is successful at reducing speeding violations and traffic crashes and casualties. With regards to physical policing methods, a study by Keall, Povey, and Frith (2001) evaluated speed radar guns operated by police in unmarked vehicles that were hidden from the road side and found a reduction of 1.4mph in the mean speed at the enforcement sites and a reduction of 1mph on all open roads in the trial area. It was also estimated that injury crashes and casualties at the enforcement sites had reduced by 22% and 29%, respectively, compared with open roads outside the trial area.

With regards to automated methods of enforcement, a report by the Department for Transport (2007) found a 32% reduction in the number of vehicles that exceeded the speed limit at speed camera sites following the introduction of speed cameras (i.e., comparison of the same sections of road before and after the introduction of the speed camera). In addition, a 33% reduction in overall collisions involving injury and a 40% reduction in the number of people killed or seriously injured was found (Armitage, 2005). Similarly, Pilkington and Kinra (2005) reviewed k=14 observational studies testing the effects of speed cameras on road traffic crashes and casualties. It was found that speed cameras were effective at reducing road traffic crashes and related casualties up to three years after the introduction of speed cameras in k=13 of the k=14 studies and in one of these studies, the reductions were sustained for 4.6 years (Elvik, 1997). In addition, a review of k=35 studies by C. Wilson, Willis, Henrikz, Le Brocque, and Bellamy (2010) found that speed cameras reduced average driving speeds by between 1% and 15% and the proportion of vehicles exceeding the speed limit by between 14% and 65%.

Despite the evidence showing that enforcement can reduce speeding behaviour and road traffic crashes and casualties, there are limited resources for enforcement (Brake, 2006), meaning that large sections of the road network, including sections of road where automated enforcement methods are in operation, are often not policed and drivers can exceed speed limits without being caught. For example, Stradling et al. (2003) found that 19% of drivers had been 'flashed' by a speed camera in preceding 3 years. However, in 81% of these cases this did not result in a fine or penalty points. Furthermore, enforcement is not an effective method for reducing speeding behaviour for all drivers. For example, Lawpoolsri, Li, and Braver (2007) showed that drivers who received a speeding citation were nearly twice as likely to receive another citation during a one-year follow-up period than were drivers who had not been cited for speeding.

Additionally, a limitation with enforcement is that its beneficial effects on speeding behaviour are constrained by time and distance halo effects (Champness, Sheehan, & Folkman, 2005). Due to the limited resources for traffic policing, physical policing methods tend to be targeted at sections of the road network for limited amounts of time and traffic speeds tend only to reduce during times of police presence and shortly after (time halo effect). For example, in a review of the literature, Elliott and Broughton (2005) found that reductions in traffic speeds due to physical policing methods lasted between 1 hour and 8 weeks after enforcement efforts had ceased. Longer durations of police presence were required to generate the longer lasting effects (e.g., up to 8 weeks). However, there was typically little or no lasting effects on traffic speeds when police presence lasted 6 days or less (Elliott & Broughton, 2005).

Similarly, research shows that vehicle speeds and traffic crashes tend only to reduce at the specific locations on the road network where enforcement is provided (distance halo effect). For example, De Pauw, Daniels, Brijs, Hermans, and Wets

(2014) found that driving speeds decreased, on average, by 6.4km/h at speed camera sites. In addition, the odds of a driver being observed to exceed the speed limit decreased by 80% and the odds of a driver exceeding the speed limit more than 10% decreased by 86%. However, driving speeds and speeding behaviour did not reduce before or after the speed camera locations. Drivers tended to slow down before the speed camera and speed up again after they passed it (De Pauw et al., 2014). Similar distance halo effects have also been observed in other studies focusing on both automated and physical policing methods (e.g., Champness et al., 2005; S. M. Christie, Lyons, Dunstan, & Jones, 2003; Hess, 2004).

Overall, therefore, enforcement is an effective strategy for reducing drivers' speeding behaviour. However, it is not effective for all drivers and its beneficial effects do not tend to persist over time (once police presence has ceased), or distance (once an enforcement site has been passed). Enforcement, therefore, does not tend to have lasting effects on speeding behaviour over the entire road network.

1.9.2 Engineering

Engineering strategies for reducing speeding behaviour include vehicle and road engineering strategies. Vehicle engineering strategies include speed limiters, which can be installed in vehicles to restrict the speed at which they can be driven. However, speed limiters typically restrict a vehicles' speed to the fastest legal speed limit. In the UK, for a car or van, this means 70mph as this is the legal speed limit for those vehicles on the fastest road types (i.e., motorways and dual carriageways with a national speed limit). This does not therefore help reduce speeding on lower speed limit roads, such as urban roads with 30mph speed limits, which have the most casualties (see section 1.3, page 2). Although intelligent speed limiters (linked with

GPS) can detect the speed limit for the road currently being driven and limit a vehicle's speed as required, research shows that experts on intelligent speed limiters have concerns regarding the technical reliability of the devices and what would happen if the devices malfunctioned (e.g., van der Pas, Marchau, Walker, van Wee, & Vlassenroot, 2012). Additionally, research shows that drivers are typically not in favour of installing speed limiters in their vehicles and would not use them even if they were installed (e.g., Comte, Wardman, & Whelan, 2000; Varhelyi, Comte, & Makinen, 1998; Várhelyi & Mäkinen, 2001). This means that speed limiters are unlikely to be successful at reducing speeding behaviour on a large scale unless they are made mandatory. However, the UK Government state that a speed limiter is only mandatory on vehicles that have more than 8 passenger seats (e.g., buses, coaches, minibuses) and goods vehicles that have a maximum laden weight of more than 3.5 tonnes (e.g., UK Government, n.d) and there are no plans to make speed limiters mandatory for other vehicle types. In addition, another method of vehicle engineering is telematics (black) boxes, which can be installed in vehicles to measures the drivers' performance (e.g., speed, acceleration, and braking). Some UK insurance companies provide incentives for drivers who opt to install a black box in their vehicle such as cheaper car insurance, as long as they drive their car safely (e.g., at an appropriate speed) However, similarly to speed limiters, these devices are not mandatory for vehicles and there are no plans to make black boxes mandatory for all drivers.

Road engineering strategies are designed to control vehicle speeds through traffic calming techniques such as road humps, rumble devices, chicanes, gateways and roundabouts. These interventions require drivers to reduce their speeds in order to be able to pass them safely (Department for Transport, 2007). However, these methods have been shown to only reduce driving speeds at the locations on the road network where they are placed; drivers tend to decrease their travelling speed when approaching these obstacles but increase their speed again after they have passed them (e.g., Boulter et al., 2001), meaning that they suffer a similar distance halo effect to police enforcement methods.

Overall, engineering strategies can be effective at reducing speeding behaviour. However, as is the case with police enforcement, their effects, over the road network generally, are limited.

1.9.3 Education

Educational interventions are designed to motivate drivers to adhere to the speed limit through the provision of information that typically highlights the consequences associated with speeding (e.g., traffic crashes and casualties or being caught by the police). This information is usually communicated to drivers through road safety advertising (e.g., radio, television, cinema or the internet), informational materials (e.g., leaflets) and driver training or rehabilitation courses (e.g., speed awareness courses, which provide an educational alternative to penalty points for drivers caught for exceeding the speed limit by up to 10%+2 to 6mph). The rationale underlying educational interventions is that making drivers aware of the negative consequences of speeding will generate attitude-change and therefore foster desirable attitudes (i.e., attitudes that are not in favour of speeding), which will subsequently be converted into safe road use (i.e., the avoidance of speeding).

The evidence for the effectiveness of road safety educational interventions is not convincing, however. For example, the UK Government's 'Kill Your Speed or

Live With It' campaign, which ran between 2009 and 2010, highlighted the psychological effects of killing child pedestrians due to speeding (e.g., in one advert, a driver was depicted as repeatedly seeing the image of a deceased child following a traffic crash caused by them exceeding the speed limit). The campaign was designed to reduce speeding in 30mph areas. However, following the campaign, there was no reduction in the prevalence of speeding 30mph areas (Department for Transport, 2013b). Similarly, the Scottish Government's 'Foolspeed' campaign, which ran between 1998 and 2002, consisted of a series of television adverts highlighting the dangers of speeding (e.g., not being in full control of the car). Again, however, the campaign was not found to generate any reductions in drivers' speeding behaviour (Stead, Tagg, MacKintosh, & Eadie, 2004). In addition, speed awareness courses are designed to change drivers' attitudes towards speeding and are offered to drivers in England and Wales who are caught for a 'low-level' speeding offence (exceeding the speed limit by 10%+2 to 6mph depending on the police enforcement area) as an alternative to receiving a fixed penalty notice. Drivers who choose to attend speed awareness courses rather than receive penalty points on their driving licence have been found to have lower re-offending rates than drivers who choose not to attend speed awareness courses (Ipsos MORI., Barrett, & the Institute for Transport Studies, 2018). However, although a variety of statistical controls have been put in place when testing the differences between these two groups (e.g., controlling for measured personal characteristics), these findings are to be treated with caution as they do not show conclusively that attending a speed awareness course causes a reduction in speeding behaviour (Ipsos MORI. et al., 2018). This is because the differences between drivers who chose to attend a course and those who did not might be due to a host of unmeasured variables reflecting differences between the two groups which influenced their decision to attend a course or not in the first place.

Overall, therefore, there is very limited evidence that road safety educational interventions, which have been implemented in the UK, can reduce speeding behaviour. Evidence from other countries reveals a similar story (e.g., Glendon, McNally, Jarvis, Chalmers, & Salisbury, 2014; Goldenbeld, Twisk, & Houwing, 2008; Olumide & Owoaje, 2016) and has led some researchers to conclude that road safety educational interventions are generally ineffective at changing behaviour (e.g., Kinnear et al., 2013). However, because educational interventions focus on attitude-change, they seek to control drivers' behaviour through internal forces (i.e. socially desirable attitudes that are not in favour of speeding; Pressley et al., 2016), Fernandez-Medina, Helman, McKenna, Stradling & Husband, 2016). Therefore, unlike enforcement and engineering strategies, which aim to reduce speeding through non-ubiquitous external forces (e.g., police presence, speed cameras or traffic calming techniques), they should, in theory, have the capacity to generate longer lasting reductions in speeding behaviour over more of the road network.

1.10 Conclusions

In conclusion, the literature reviewed in this chapter shows that speeding has a negative impact on road safety, the economy and individuals' health and well-being. Despite this, however, it is a highly prevalent behaviour. Interventions to reduce speeding include enforcement and engineering, both of which suffer limitations, including effects on driving behaviour that are short-lived and restricted to specific locations on the road network. Although there is a general lack of evidence showing that educational interventions have been successful at reducing speeding, educational interventions have, in theory, the potential to overcome the limitations with enforcement and engineering because they are designed to motivate drivers to adhere to the speed limit through attitude-change and therefore internally motivate the avoidance of speeding rather than restricting it through non-ubiquitous external constraints. For this reason, chapter 2 will consider the reasons why road safety educational interventions have, in general, not been shown to be effective at reducing drivers’ speeding behaviour with a view to understanding ways in which it might be possible to increase intervention effectiveness.

Chapter 2: What 'drives' speeding behaviour?

2.1 Chapter Summary

This chapter describes the background to the work presented in this thesis. It summarises the attitude-behaviour relationship by describing social cognition models that include attitude as a construct, and also different conceptualisations of the attitude construct. This chapter also discusses previous attitude change interventions and possible reasons for the apparent ineffectiveness of these interventions in order to understand what the research in this thesis needs to do in order to change attitudes and behaviour.

2.2 Introduction

The previous chapter highlighted the prevalence of speeding behaviour in the UK and the problems that it causes for road safety, the economy and health and wellbeing. However, as also discussed in the previous chapter, speeding is a behaviour that has proved difficult to change. Of relevance to this thesis, educational interventions, which aim to reduce speeding by modifying drivers' attitudes, have had limited effects on speeding behaviour.

Chapter 2 of this thesis will provide a review of the literature on attitudes with a view to understanding why educational interventions may have been found to have limited effects on speeding behaviour. Theoretical research on the attitude-behaviour relationship will be reviewed in section 2.3 to gauge the extent to which attitudes predict speeding behaviour and the scope for reducing speeding by modifying attitudes. This will include a review of social cognition (attitude-behaviour) models along with the associated empirical evidence (section 2.3.1) and a review of relevant research on the different conceptualisations of the attitude construct and the prediction of behaviour from different types of attitudes (section 2.3.2). Next, a review of the literature on attitude-change interventions in the context of speeding behaviour will be presented (section 2.4) with a view to identifying whether previous approaches to changing attitudes might be limited and how they could be improved. Finally, conclusions will be made and the implications for effectively changing behaviour will be identified.

2.3 The attitude-behaviour relationship

2.3.1 Social cognition models

Although the examination of the relationship between attitudes and behaviour has a long history in social psychology (e.g., Thurstone, 1931), it has been studied primarily within the context of social cognition models within the contemporary literature. Social cognition models specify a series of constructs that are held to determine behaviour. Most of these models include attitudes as one of their constructs. In the following subsections, the key social cognitive models in the literature will be reviewed along with the associated empirical evidence in order to gauge the importance of attitudes in the prediction of behaviour and thus how much potential there is to change behaviour by changing attitudes. The models reviewed are the Theory of Reasoned Action (Fishbein & Ajzen, 1975); the Theory of Planned Behaviour (Ajzen, 1985, 1991); the Prototype Willingness Model (Gibbons & Gerrard, 1995); and the Motivation and Opportunity Determinants (MODE) Model (Fazio, 1990a; Fazio & Towles-Schwen, 1999; Fazio & Williams, 1986). These models explicitly include attitudes as predictors of behaviour and they have been tested across various health and social behaviours (e.g., contraceptive use, alcohol consumption, healthy-eating, voting behaviour, education attainment), including driving behaviour. Other social cognition models, such as the Health Belief Model (Rosenstock, 1974) and Protection Motivation Theory (Maddux & Rogers, 1983) are not covered because they do not explicitly include attitudes as predictors of behaviour. However, it should be noted that whilst these other models do not explicitly refer to attitudes, they include constructs that tap evaluations of behaviour, and therefore, implicitly refer to attitudes. Thus, even in models that do not explicit refer to attitudes; attitudes are viewed as an important predictor of behaviour.

2.3.1.1 Theory of Reasoned Action

The Theory of Reasoned Action (Fishbein & Ajzen, 1975; see Figure 2.1) is a model of deliberative decision-making, which maintains that attitudes (positive or negative evaluations of behaviour; e.g., “For me, speeding is good/bad”), along with subjective norms (perceived pressure from important social referents to perform a behaviour; e.g., “People who are important to me would/ would not approve of me exceeding the speed limit”), combine to determine individuals’ behavioural intentions (overall motivation to perform a behaviour; e.g., “I intend/do not intend to exceed the speed limit”). Behavioural intentions are, in turn, held to be a direct proxy for behaviour. In the present context, for example, drivers would be more likely to speed if they develop behavioural intentions that are based on positive (rather than negative) attitudes towards speeding and subjectively held normative beliefs that important social referents would approve (rather than disapprove) of them exceeding the speed limit.

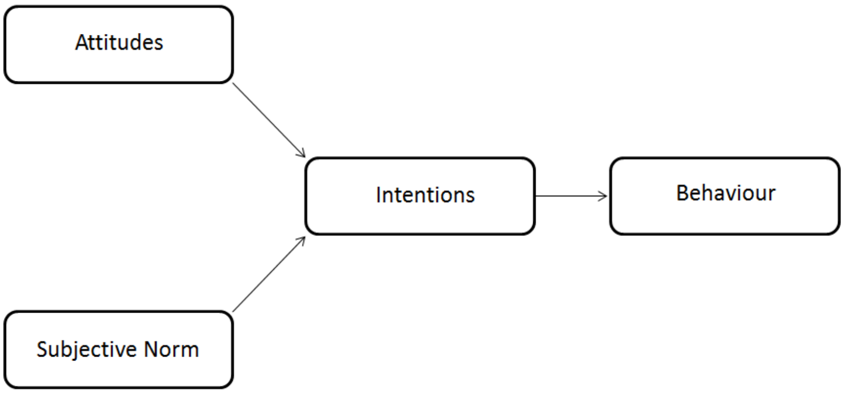

Figure 2.1. The Theory of Reasoned Action

General support for the Theory of Reasoned Action comes from meta-analyses of studies that focus on a variety of health-related behaviours. A meta-analysis conducted by Albarracín, Johnson, Fishbein, and Muellerleile (2001) examining k=96 studies that focused on condom use found that the sample weighted mean correlations between attitudes and behavioural intentions and subjective norms and behavioural intentions were $r+ = 0.58$ and $r+ = 0.39$, respectively, and the sample weighted mean correlation between intentions and behaviour was $r+ = 0.45$. Similarly, a meta-analysis conducted by Hagger, Chatzisarantis, and Biddle (2002) examining k=72 studies that focused on exercise behaviour found that the sample weighted mean correlations between attitudes and behavioural intentions and subjective norms and behavioural intentions were $r+ = 0.60$ and $r+ = 0.32$, respectively, and the sample weighted mean correlation between behavioural intentions and behaviour was $r+ = 0.57$. In addition, a meta-analysis conducted by Cooke and French (2008) examining k=33 studies that focused on screening test attendance behaviour found that the sample weighted mean correlations between attitudes and behavioural intentions and subjective norms and behavioural intentions was *r*+ = 0.51 and *r*+ = 0.41, respectively, and the sample weighted mean correlation between behavioural intentions and behaviour was *r*+ = 0.42.

In the social sciences, a correlation of $r < 0.10$ is regarded as a negligible effect-size, a correlation of $r = 0.10$ is regarded as 'small' effect-size, a correlation of $r = 0.30$ is regarded as a 'moderate' effect-size and a correlation of $r = 0.50$ is regarded as a 'large' effect-size (Cohen, 1992). The effect size, therefore, demonstrates the strength of the relationship between two variables. Thus, the above cited meta-analyses provide good support for the Theory of Reasoned Action. Typically, the correlation between behavioural intentions and behaviour exceeds or approaches a large effect size, the correlation between attitudes and behavioural intentions is in excess of a large effect size and the correlation between subjective norms and behavioural intentions is a moderate effect size. What is noteworthy here is that attitudes have consistently been found to be more strongly correlated with behavioural intentions than subjective norms, implying that they dictate behaviour to a greater extent, and, therefore, represent a more effective lever for modifying behaviour.

In the context of speeding specifically, empirical research also provides support for the Theory of Reasoned Action and has shown a general pattern of results that is consistent with the above cited meta-analyses of general health behaviours. For example, data collected by Elliott et al. (2007) showed that speeding intentions accounted for 51% ($R^2 = .52$) of the variance in self-reported speeding behaviour and between 29% to 38% of the variance ($R^2 = .29$ to .38) in objectively measured speeding behaviour (the percentage of a simulator drive that was spent over the speed limit) across four specific road types (i.e., urban distributor roads, rural single carriageway roads, village through-roads and motorways). Attitudes and subjective norms accounted for 48% ($R^2 = .48$) of the variance in speeding intentions but, in line with the findings of the above cited meta-analyses, attitudes were better predictors of intentions ($\beta = 0.62$, $p < .001$) than were subjective norms ($\beta = 0.16$ $p < .05$). While there are some studies that have shown that subjective norms are better at predicting speeding than attitudes (e.g., Parker, Manstead, Stradling, Reason, & Baxter, 1992), most studies (e.g., Cestac, Paran, & Delhomme, 2011; Conner et al., 2007: study 2; Dinh & Kubota, 2013; Forward, 2009; Rowe et al., 2016) have been in line with the findings of Elliott et al. (2007) and in some cases, attitudes have been found to be an independent predictor of behaviour whilst subjective norms are not (e.g., Parker, Lajunen, & Stradling, 1998). Overall, the implication is that attitudes are the stronger dictators of speeding and represent a more effective lever for reducing this behaviour.

2.3.1.2 Theory of Planned Behaviour

The Theory of Planned Behaviour (Ajzen, 1985; 1991; see Figure 2.2) is an extension of the Theory of Reasoned Action. The Theory of Planned Behaviour argues, like the Theory of Reasoned Action, that attitudes along with subjective norms combine to determine an individual's behavioural intentions. However, this theory also argues that perceived behavioural control (perceived ability to perform a behaviour; e.g., "For me, speeding is easy/difficult") is another determinant of behavioural intentions. Behavioural intentions are, in turn, direct proxies for behaviour, as in the Theory of Reasoned Action. In the present context, drivers are more likely to speed if they develop behavioural intentions that are based on positive (rather than negative) attitudes towards speeding, subjectively held normative beliefs that important social referents would approve (rather than disapprove) of them exceeding the speed limit, and beliefs about having control over the performance of this behaviour. Perceived behavioural control is also argued to be a direct determinant of behaviour in addition to behavioural intention, meaning that drivers are more likely to speed if they intend to perform this behaviour and if they believe they have the ability to do so.

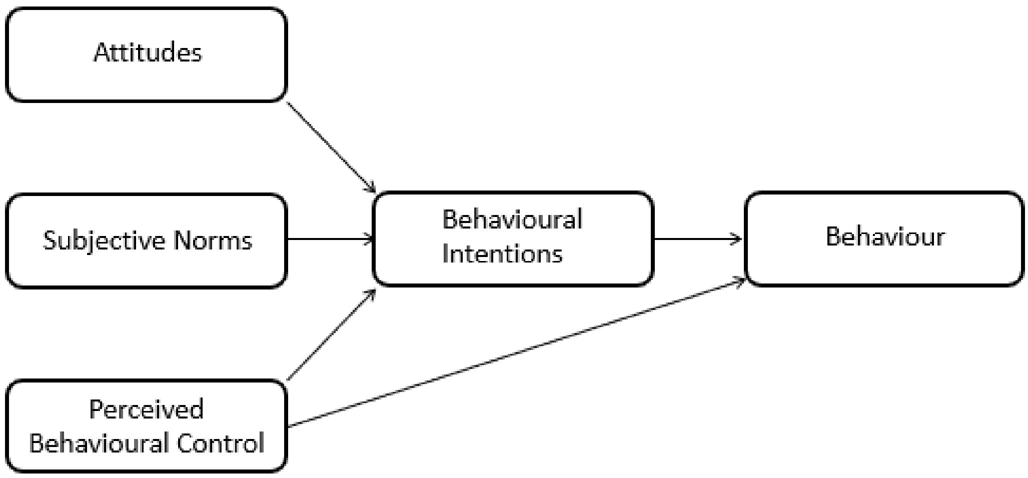

Figure 2.2. The Theory of Planned Behaviour

General support for the Theory of Planned Behaviour comes from meta-analyses of studies that focus on a variety of social and health-related behaviours. A meta-analysis conducted by Armitage and Conner (2001) examining k=185 studies focusing on a range of social behaviours (e.g., contraception use, voting, and physical activity) demonstrated that the sample weighted mean correlations between attitudes and behavioural intentions, subjective norms and behavioural intentions, and perceived behavioural control and behavioural intentions were $r+ = 0.49$, $r+ = 0.34$, and $r+ = 0.43$, respectively. The sample weighted mean correlations between intentions and behaviour, and perceived behavioural control and behaviour were *r*+ = 0.47 and *r*+ = 0.37, respectively. Similar results were found by McEachan, Conner, Taylor, and Lawton (2011) in a meta-analysis specifically focusing on *k*=237 studies of health behaviour. In McEachan et al. (2011)'s meta-analysis, the sample weighted mean correlations between attitudes and behavioural intentions, subjective norms and behavioural intentions, and perceived behavioural control and behavioural intentions were *r*+ = 0.57, *r*+ = 0.40, and *r*+ = 0.54, respectively. The sample weighted mean correlations between intentions and behaviour, and perceived behavioural control and behaviour were *r*+ = 0.43 and *r*+ = 0.31, respectively. A more recent meta-analysis by Cooke, Dahdah, Norman, and French (2014) focusing on *k*=40 studies that had been conducted on alcohol consumption also found similar results. In this meta-analysis, it was found that the sample weighted mean correlations between attitudes and behavioural intentions, subjective norms and behavioural intentions, and perceived behavioural control and behavioural intentions were *r*+ = 0.62, *r*+ = 0.47, and *r*+ = 0.31, respectively. The sample weighted mean correlations between behavioural intentions and behaviour, and perceived behavioural control and behaviour were *r*+ = 0.54 and *r*+ = -0.05 respectively.

These meta-analyses provide good support for the Theory of Planned Behaviour. In line with the evidence for the Theory of Reasoned Action, attitudes have generally been found to be more strongly correlated with behavioural intentions than subjective norms and perceived behavioural control. Typically, the average correlations between attitudes and behavioural intentions exceed or approach a large effect size, whereas the correlations between subjective norms and behavioural intentions and perceived behavioural control and behavioural intentions are a moderate effect size. In turn, the average correlation between behavioural intentions and behaviour exceeds or approaches a large effect size whereas the correlation between perceived behavioural control and behaviour is typically a moderate effect size.

In the context of speeding, empirical research has also provided support for the Theory of Planned Behaviour and has revealed a general pattern of results that is consistent with the above cited meta-analyses of general health behaviours. For example, (Conner et al., 2007: study 2) found that behavioural intentions and perceived behavioural control, along with demographic variables (e.g., age, sex, annual mileage), accounted for 19% ($R^2 = .19$) of the variance in objectively measured speeding behaviour (on-road vehicle speeds as measured by speed cameras) with behavioural intentions being the principal predictor of behaviour (β=0.39, $p < .01$ compared with β=-0.01, $p > .05$ for perceived behavioural control). Attitudes, subjective norms and perceived behavioural control, along with the demographic variables together accounted for 63% ($R^2 = .63$) of the variance in behavioural intentions to speed. Attitudes, subjective norms and perceived behavioural control each had significant independent effects on behavioural intentions but attitudes (β=0.54, $p < .001$) more strongly predicted behavioural intentions than did subjective norms (β=-0.12, $p < .01$) or perceived behavioural control (β=0.31, $p < .001$). There are some studies showing that subjective norms (e.g., Parker et al., 1992) are better at predicting behaviour than are attitudes, which may suggest that those drivers perceive their speeding behaviour to have potentially negative consequences for others who are important to them, which dictated their behaviour more so than their attitudes. Similarly, there are some studies showing that perceived behavioural control (e.g., Elliott, Armitage, & Baughan, 2003) are better at predicting speeding than are attitudes, which may suggest that those drivers perceive their speeding behaviour as not something that is under their volitional control, which dictated their behaviour more so than their attitudes. However, even in those studies, attitudes are still important predictors of speeding behaviour and most studies are in line with Conner et al. (2007: study 2)'s findings (e.g., Cestac et al., 2011; Dinh & Kubota, 2013; Elliott et al., 2007; Forward, 2009; Rowe et al., 2016), implying again that attitudes are important in dictating speeding behaviour and represent an effective lever for modifying this behaviour.

2.3.1.3 Prototype Willingness Model

The Prototype Willingness Model (Gibbons & Gerrard, 1995; see Figure 2.3) was designed to explain the deliberative *and* reactive aspects of the decision to engage in health-risk behaviours. Consistent with the Theory of Reasoned Action and the Theory of Planned Behaviour, the Prototype Willingness Model posits that behaviour has a deliberative (i.e., reasoned or planned) component, as it argues that attitudes and subjective norms influence behavioural intentions, which, in turn, determines behaviour. In addition, the model argues that there is also a more reactive component to behaviour. Specifically, the model argues that behaviour is also determined by behavioural willingness (an openness to engage in the behaviour if the opportunity to engage in that behaviour arises; e.g., "I would be willing to speed if I was in a situation where others were also speeding"). It also argues that behavioural willingness is determined by prototype perceptions in addition to attitudes and subjective norms. There are two types of prototype perceptions that are often examined when testing this theory: prototype similarity perceptions (the extent to which individuals believe that they are similar to the typical person who often engages in the behaviour; e.g., “I am similar to the types of people who regularly speed”) and prototype favourability perceptions (the extent to which individuals evaluate the prototypical person who performs the behaviour as being positive or negative; e.g., “The typical driver who engages in speeding behaviour is cool”).

Therefore, in the context of speeding, the Prototype Willingness Model would suggest that drivers are more likely to speed if they form a deliberative intention to speed and if they have a general willingness to speed in response to appropriate opportunities. In turn, drivers are likely to develop an intention to speed and be more willing to speed if they have positive attitudes towards speeding and perceive that the people who are close to them would want them to speed. Additionally, they are more likely to be willing to speed if they perceive they are similar to the typical speeder and perceive the typical speeder favourably.

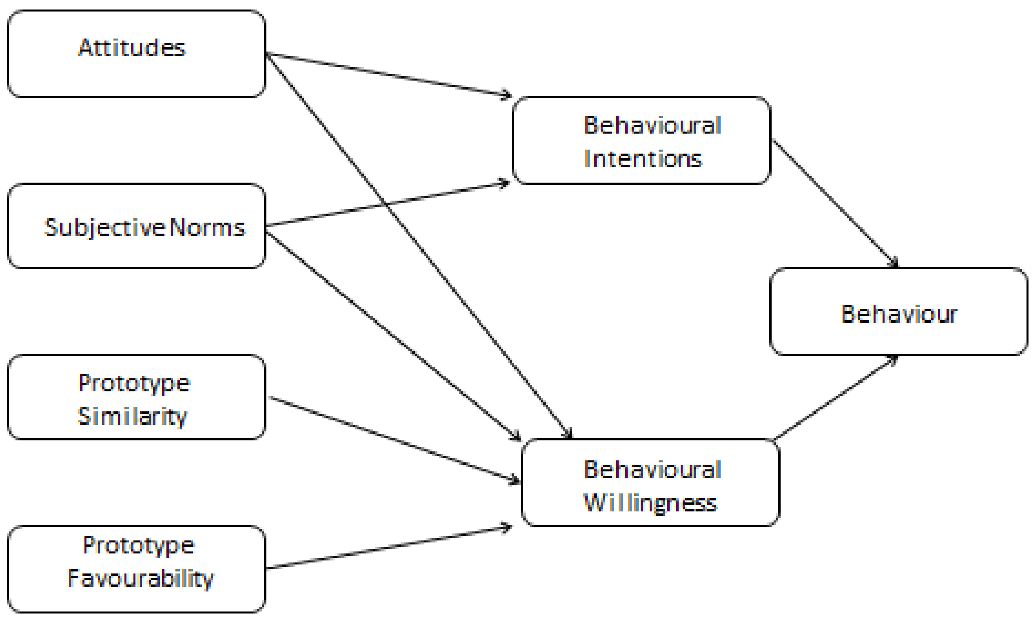

Figure 2.3. The Prototype Willingness Model.

Although several meta-analyses provide support for the prototype willingness model, few studies (e.g., Branley & Covey, 2018; Elliott et al., 2017) provide a simultaneous test of all the relationships that are proposed by this theory. As a result, meta-analyses have typically focused on the effects of prototype perceptions on both behavioural intentions and behavioural willingness and the effects of both behavioural intentions and behavioural willingness on behaviour (e.g., Todd, Kothe, Mullan, & Monds, 2014; van Lettow, de Vries, Burdorf, & van Empelen, 2016). The effects of attitudes and subjective norms on both behavioural intentions and behavioural willingness have typically not been examined in meta-analytic studies. That said, there are individual studies in which researchers have tested the effects of attitudes, subjective norms and prototype perceptions on behavioural intentions (e.g., Rivis, Sheeran, & Armitage, 2006) and others in which researchers have tested the effects of these constructs on behavioural willingness (e.g., Rivis, Abraham, & Snook, 2011). These studies have shown that attitudes are either the largest predictor of behavioural intentions or behavioural willingness, or are one of the largest predictors. For example, in the context of speeding specifically, Preece, Watson, Kaye, and Fleiter (2018) found that attitudes were the strongest predictors of behavioural willingness to speed by 10km/h over the speed limit (β=0.45, p <.001) and by up to 10km/h over the speed limit (β=0.48, p <.001) compared to subjective norms (β=0.22, p <.05 for speeding in excess of 10k/h and β=0.12, p <.001 for speeding up to 10km/h over the speed limit) and prototype perceptions (β=0.10, p <.001 for speeding in excess of 10k/h and β=0.11, p > .05 for speeding up to 10km/h over the speed limit).

In addition, there is one previous study in which researchers have provided a full test of the Prototype Willingness Model in the context of speeding behaviour. Elliott et al. (2017) tested both the deliberative and reactive decision making aspects of the model. Path analysis showed that the constructs in the model together accounted for 89% of the variance in subsequent speeding behaviour. Attitudes were stronger predictors of speeding behaviour through behavioural intentions (β for the attitude-behavioural intention relationship = 0.40, $p < .001$ and β for the behavioural intention-behaviour relationship = .24, $p < .001$) than were subjective norms (β for the subjective norms-behavioural intention relationship = 0.12, $p = .048$), prototype similarity perceptions (β for the prototype similarity perceptions-behavioural intention relationship = 0.11, $p = .088$) and two types of prototype favourability perceptions that focused on the positive or negative attributes of the typical speeder (β for the positive prototype favourability perception-behavioural intention relationship = 0.05, $p = .346$ and β for the negative prototype favourability perception-behavioural intention relationship = 0.03, $p = .601$).

Attitudes were also found to be significant predictors of speeding behaviour through behavioural willingness (β for the attitude-behavioural willingness relationship = 0.23, $p = .001$ and β for the behavioural willingness-behaviour relationship = 0.52, p < .001). Subjective norms (β for the subjective norm-behavioural willingness relationship = 0.19, $p = .002$) and prototype similarity perceptions (β for the prototype similarity perceptions-behavioural willingness relationship = 0.32, $p < .001$) also predicted speeding behaviour through behavioural willingness to approximately the same extent as attitudes did. However, prototype favourability perceptions were not found to predict behaviour through behavioural willingness (β for the positive prototype favourability perceptions-behavioural intention relationship = 0.05, p =.369 and β for the negative prototype favourability perceptions-behavioural intention relationship = -0.08, p = .136).The results therefore implied that attitudes had more bearing, overall, on the extent to which drivers exceeded the speed limit than did the other constructs in the prototype willingness model (i.e., they predicted speeding through both behavioural intentions and behavioural willingness whereas prototype perceptions did not, and while subjective norms also predicted behaviour through both behavioural intentions and behavioural willingness, they were not as strong as predictors of behavioural intentions as were attitudes).

2.3.1.4 Motivation and Opportunity Determinants (MODE) Model

Another theory that focuses specifically on the attitude-behaviour relationship is the Motivation and Opportunity Determinants (MODE) Model (see Figure 2.4). This model provides an account of how attitudes influence behaviour through deliberative and automatic processes (e.g., Fazio, 1990a; Fazio & Towles-Schwen, 1999; Fazio & Williams, 1986). According to the model, attitudes need to be retrieved from memory in order to guide behaviour. Attitudes can be retrieved from memory through a deliberative processing mode that occurs when individuals are motivated and have the opportunity to reflect on their attitudes (e.g., consider the positive and negative attributes of a behaviour). However, individuals can often lack the motivation or opportunity to deliberate before behaving (see Fazio, 2001; Olson & Fazio, 2009). In these cases, it is proposed that attitudes can influence behaviour through an automatic processing mode when individuals encounter salient cues associated with the attitude-relevant behaviour. For example, when drivers encounter situations that they associate with speeding (e.g., through having performed this behaviour repeatedly in the past in similar situations; cf. Ouellette & Wood, 1998), their attitudes will be retrieved from memory spontaneously (i.e., with little conscious thought) and guide behaviour automatically (i.e., without conscious awareness of the attitude). For attitudes to be retrieved from memory in this way, they need to be accessible, or mentally available. Attitude accessibility therefore dictates the extent to which attitudes are predictive of behaviour, according to the MODE model, with increased attitude accessibility leading to increases in attitude-behaviour correspondence (Fazio, 2001; Olson & Fazio, 2009).

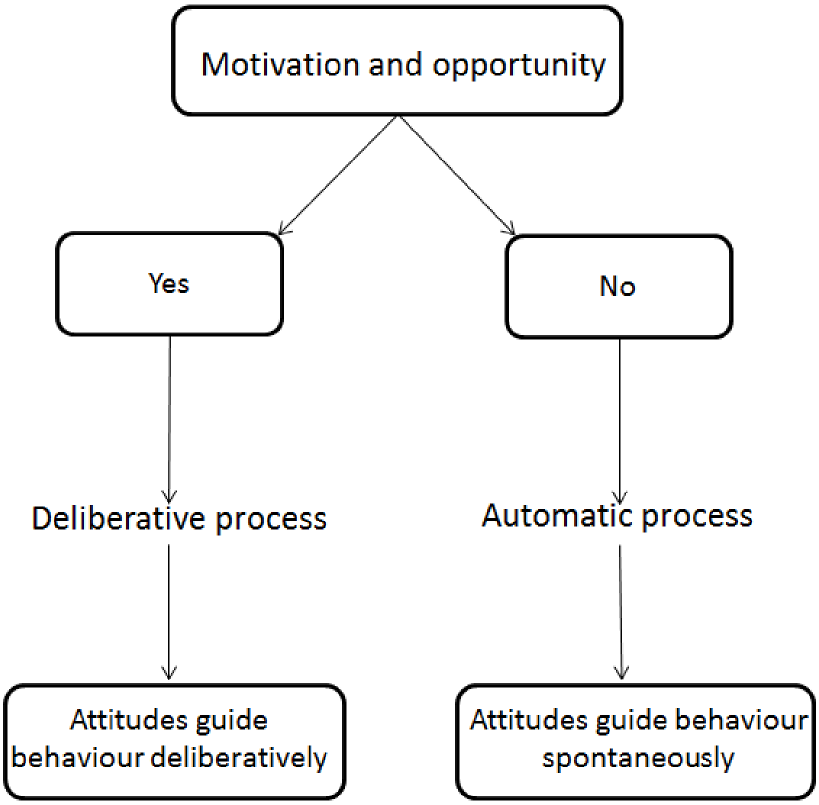

Figure 2.4. Motivation and Opportunity Determinants (MODE) Model.

General support for the proposition that attitude accessibility increases attitude-behaviour correspondence comes from previous studies showing that shorter latencies of response to attitudinal enquiries (typically used as operational measures of attitude accessibility) augment the relationship between attitudes and behaviour (e.g., Fazio, Powell, & Williams, 1989; Fazio & Williams, 1986). In the context of speeding, only two studies, both reported by Elliott, Lee, Robertson, and Innes (2015), have investigated this issue. In study 1, Elliott, Lee, et al. (2015) found that attitudes were significantly stronger predictors of speeding behaviour when the accessibilities of those attitudes (as measured by participants' latencies of response to a questionnaire measure of attitudes towards speeding) were high (β = 0.83, p < .001) compared to when they were low (β = 0.37, p < .01). In both cases, however, attitudes were significant predictors of behaviour. In study 2, Elliott, Lee, et al. (2015) found that asking participants in an experimental condition to repeatedly answer questionnaire items about their attitudes towards speeding increased the accessibility of their attitudes relative to participants in a control condition, who were asked to repeatedly express their attitudes towards a different behaviour (engaging in a binge-drinking session). Subsequently, the attitudes of the experimental participants were stronger predictors of behaviour (β = 0.61, p < .001) than were the attitudes of the control participants (β = 0.29, p = .07). However, in both cases attitudes were significant predictors of behaviour. These findings therefore provide support for the main tenets of the MODE model, and highlight the importance of attitudes in the prediction of speeding behaviour through processes that are held to be relatively deliberative (low attitude accessibility) and spontaneous (high attitude accessibility).

2.3.1.5 Summary of social cognition models

As the review of the above mentioned social cognition models shows, attitudes are widely regarded as key predictors of behaviour. Depending on the theoretical model, the way in which attitudes are held to be important in the prediction of behaviour differs. In some models, attitudes are held to predict behaviour through deliberative decision-making processes reflected in constructs such as behavioural intentions (e.g., Theory of Reasoned Action, and Theory of Planned Behaviour). In other models, attitudes are also held to be important in the prediction of behaviour through more reactive or automatic decision-making processes, reflected in constructs such as behavioural willingness (e.g., Prototype Willingness Model) or attitude accessibility (e.g., the MODE model). Regardless, it is clear that attitudes are proposed to be important causal determinants of behaviour by theoretical psychologists. Furthermore, the applied evidence reviewed above for the various social cognition models provides support for this theoretical proposition. Attitudes have been found to predict behaviour through behavioural intentions in studies using the theoretical frameworks of the Theories of Reasoned Action and Planned Behaviour and the Prototype Willingness Model. They have also been found to predict behaviour through behavioural willingness when using the Prototype Willingness Model, and they have been found to predict behaviour directly in studies focusing on the MODE model. Furthermore, attitudes are regularly found to be the biggest predictors of behaviour in previous research. This is the case in studies of various social and health behaviours including speeding.

The next subsection, therefore, focuses more squarely on the construct of attitude by examining developments in the conceptualisation of this predictor of behaviour, which have led to the identification of different, theoretically distinct types of attitudes and associated research that has aimed to identify which of these types of attitudes are the best predictors of behaviour. This is to allow a conclusion to be reached about the kinds of attitudes that interventions are likely to need to change in order to reduce drivers' speeding behaviour and the extent to which previous interventions may have achieved these changes.

2.3.2 Different types of attitudes

There is a wide literature in Psychology that aims to distinguish between different types of attitudes and the extent to which they influence behaviour. For example, researchers have distinguished between cognitive attitudes (positive or negative instrumental evaluations; e.g., "For me, speeding is harmful/ beneficial") and affective attitudes (e.g., positive or negative emotional evaluations; e.g., "For me, speeding is enjoyable/ unenjoyable") and have shown that affective attitudes are typically the better predictors of risky health behaviours (e.g., Lawton, Conner, & McEachan, 2009; Rhodes, Blanchard, & Matheson, 2006) including speeding (e.g., Conner et al., 2007; Elliott & Thomson, 2010; Elliott, Thomson, Robertson, Stephenson, & Wicks, 2013). However, there are two key conceptualisations of attitudes that are relevant to the research presented in this thesis. The first is the idea that attitudes are bi-dimensional constructs; that is, they comprise separate positive and negative dimensions. The second is the idea that attitudes can be explicit (attitudes of which an individual is consciously aware) or implicit (attitudes of which an individual is not consciously aware). These conceptualisations of the attitude construct are reviewed below along with the associated research evidence highlighting the extent to which the different types of attitudes predict behaviour.

2.3.2.1 Bi-dimensional attitudes

According to traditional conceptualisations of the attitude construct (e.g., Allport, 1935; Osgood, Suci, & Tannenbaum, 1957; Thurstone, 1928), attitudes are unidimensional, meaning that individuals are held to evaluate behaviours along a single bi-polar, positive-negative dimension. As a result, attitudes are operationally measured using single, bi-polar semantic-differential scales whereby participants are presented with an attitude item (e.g., "For me, speeding is…) and asked to complete it by providing a response on a scale somewhere between extremely positive and extremely negative (e.g., Osgood et al., 1957). The likelihood of a behaviour being performed is then held to increase with the extent to which it is evaluated positively rather than negatively (e.g., Fishbein, 1963). However, this unidimensionality of the attitude construct has previously attracted criticism (e.g., Kaplan, 1972) because it makes the midpoint of a bipolar attitude scale ambiguous. More specifically, the mid-point between an evaluation that expresses extreme positivity and extreme negativity can indicate either attitudinal indifference (i.e., a state that occurs when a behaviour is simultaneously evaluated as neither positive nor negative) or attitudinal ambivalence (i.e., a state that occurs when a behaviour is simultaneously evaluated as both positive and negative).

As a solution to this problem, Kaplan (1972) recommended splitting the single positive/ negative attitude dimension at its mid-point, thus producing a positive dimension and a separate negative dimension (i.e., bi-dimensional attitudes). Operationally, Kaplan (1972) recommended the split semantic differential technique as a method for measuring the two attitude dimensions. The split semantic differential technique involves asking participants to evaluate the positive and negative attributes (consequences) of a behaviour independently on separate unipolar scales, one that taps the extent to which a behaviour is evaluated positively (e.g., “Think only about the positive outcomes that you associate with driving faster than the speed limit. How positive are they?”), and one that taps the extent to which a behaviour is evaluated negatively (e.g., “Think only about the negative outcomes that you associate with driving faster than the speed limit. How negative are they?”). This removes the ambiguous mid-point of a single attitude scale and, conceptually speaking, acknowledges the possibility that positive and negative attitudes towards the same behaviour can co-exist (Thompson, Zanna, & Griffin, 1995). Consequently, the likelihood of a behaviour being performed is held to increase both with the extent to which it is evaluated positively and not evaluated negatively (Elliott, Brewster, Thomson, Malcolm, & Rasmussen, 2015; McCartan & Elliott, 2018; McCartan, Elliott, Pagani, Finnegan, & Kelly, 2018).

In support of the bi-dimensional conceptualization of an attitude, studies employing exploratory (e.g., Conner et al., 2002; Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018) and confirmatory (e.g., McCartan & Elliott, 2018) factor analysis have demonstrated that items tapping separate positive and negative behavioural evaluations load separately onto two independent dimensions. However, attitudes have continued to be treated as unidimensional constructs when testing the relationships between attitudes, on the one hand, and measures of behavioural intentions or subsequent behaviour, on the other (see section 2.3.1). This is even the case in the literature on attitudinal ambivalence where the distinction between the positive and negative attitudes dimensions is of critical importance (for a review see Conner & Sparks, 2002). In that literature, a primary focus has been to demonstrate that evaluative conflict between the separate positive and negative attitude dimensions (i.e., attitude ambivalence) moderates the relationship between overall (i.e., unidimensional) measures of attitudes, on the one hand, and measures of behavioural intentions or subsequent behaviour, on the other, with greater evaluative conflict (attitudinal ambivalence) leading to poorer attitude-behaviour relationships (see Conner & Sparks, 2002). The rationale is that the evaluative conflict, which stems from simultaneously evaluating a behaviour as both positive and negative, is indicative of weak attitudes, which are poor predictors of behaviour (Glasman & Albarracin, 2006; Kraus, 1995).

Notwithstanding the importance of research on attitudinal ambivalence, a serious acceptance of the bi-dimensional conceptualisation of attitudes requires that the positive and negative dimensions are treated as independent predictors of behaviour. Treating the separate positive and negative attitude dimensions as independent predictors of behaviour is important as it allows researchers to test potential differences between their predictive validities, which has important implications for better understanding behaviour (i.e., which attitude dimension is the better predictor of behaviour?) and the development of effective interventions (i.e., which attitude dimension might need prioritising in behaviour-change efforts).

Recent research in which attitudes have been treated as bi-dimensional predictors of behaviour (Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018) has shown that both the positive and negative attitude dimensions independently predict binge-drinking intentions (Elliott, Brewster, et al., 2015: studies 1 and 2), smoking and unhealthy dieting intentions (Elliott, Brewster, et al., 2015: study 2), self-reported speeding behaviour (Elliott, Brewster, et al., 2015: study 3) and objectivity measured speeding behaviour (McCartan & Elliott, 2018). These studies have also shown that the positive dimension of attitude is a significantly stronger predictor of both behavioural intentions and subsequent behaviour than is the negative dimension. Specifically, Elliott, Brewster, et al. (2015) found that, relative to the negative attitude dimension, the positive attitude dimension was more predictive of behavioural intentions to binge-drink (in study 1, β for the positive attitude dimension = 0.57, $p < .01$ and β for the negative attitude dimension = -0.17, $p < .05$; in study 2, β for the positive attitude dimension = 0.64, $p < .01$ and β for the negative attitude dimension = -0.18, $p < .01$), smoke (β for the positive attitude dimension = 0.62, $p < .01$ and β for the negative attitude dimension = -0.25, $p < .01$) and consume an unhealthy diet (β for the positive attitude dimension = 0.52, $p < .01$ and β for the negative attitude dimension = -0.17, $p < .01$). More relevant to the present context, Elliott, Brewster, et al. (2015) found that the positive attitude dimension was more predictive of self-reported speeding behaviour on two road types (urban and rural roads) than was the negative attitude dimension (for speeding on urban roads, β for the positive attitude dimension = 0.31, $p < .002$ and β for the negative attitude dimension = -0.11, $p < .001$; for speeding on rural roads, β for the positive attitude dimension = 0.38, $p < .002$ and β for the negative attitude dimension = -0.11, $p < .002$). In a subsequent study, McCartan and Elliott (2018) found that the positive attitude dimension was more predictive of objectively measured speeding behaviour on a driving simulator than was the negative attitude dimension (β for the positive attitude dimension = 0.46, $p < .001$ and β for the negative attitude dimension = -0.21, $p < .05$).

It is worth noting that these findings are in line with the majority of previous studies on expectancy beliefs (precursors to attitudes) in which beliefs about the likelihood of positive behavioural outcomes (e.g., getting to one's destination quickly due to speeding) have been found to predict behaviour to a greater extent than beliefs about the likelihood of negative behavioural outcomes (e.g., getting caught by the police). For example, Lee, Greely, and Oei (1999) found that positive expectancy beliefs accounted for more variance in binge drinking behaviour than did negative expectancy beliefs. Lawton, Conner, and Parker (2007: study 2) found that positive expectancy beliefs had larger standardised regression weights than did negative expectancy beliefs in the prediction of smoking behaviour (also see Anderson, Pollak, & Wetter, 2002). Similarly, Rhodes and Conner (2010) found that positive expectancy beliefs had larger standardised regression weights than did negative expectancy beliefs in the prediction of physical activity intentions. Furthermore, Fromme, Katz, and Rivet (1997) found that positive expectancy beliefs had larger standardized regression weights than did negative expectancy beliefs in the prediction of a range of behaviours including drug-use, heavy-drinking and engagement in illegal activities such as drink-driving. Although one study by Lawton et al. (2007: study 1) found that expectancy beliefs about negative affective outcomes had larger standardised regression weights in the prediction of speeding behaviour than did expectancy beliefs about positive affective outcomes, it is clear that the findings of previous research suggest a 'positivity bias' in behavioural decision-making (e.g., Boucher & Osgood, 1969). With regards to bi-dimensional attitudes, evaluations of positive behavioural outcomes outweigh evaluations of negative behavioural outcomes in the prediction of behaviour (but see Lawton et al., 2007: study 1).

It is also worth noting that recent research on bi-dimensional attitudes has shown that attitude accessibility helps explain why the positive attitude dimension is the stronger predictor of speeding than the negative dimension (McCartan & Elliott, 2018). In McCartan and Elliott (2018), the rationale was that the positive outcomes of speeding (e.g., getting to one's destination quicker) are typically more immediate, frequent and guaranteed than most of the negative outcomes (e.g., a traffic crash or being caught by the police; also see Elliott, Brewster, et al., 2015). This should result, on average, in the positive attitude dimension being reinforced to a greater extent than the negative dimension. In turn, the association between the behaviour of speeding and evaluations that lie on the positive dimension of attitude (i.e., not at all positive to extremely positive) should be stronger than the association between the behaviour of speeding and evaluations that lie on the negative dimension of attitude (i.e., not at all negative to extremely negative). As a result, the positive attitude dimension should be more chronically accessible in memory and therefore more predictive of behaviour (cf. Fazio, 1990a). In support of this rationale, McCartan and Elliott (2018) found that drivers responded significantly quicker to questionnaire items measuring the positive dimension of their attitudes towards speeding than they did questionnaire items measuring the negative dimension of their attitudes, indicating that the positive attitude dimension was more accessible in memory than was the negative attitude dimension (see Fazio, 1990b). They also found that this difference in the response latencies to the items measuring the positive and negative attitudes dimensions significantly mediated the different extents to which the positive and negative attitude dimensions of drivers' attitudes predicted their speeding behaviour on a simulator.

In summary, research on bi-dimensional attitudes has demonstrated that attitudes can comprise two separate positive and negative dimensions. The positive dimension of attitudes has been found to be more predictive of behaviour compared to the negative dimension. This has been demonstrated for several behaviours including speeding and is in line with research on expectancy beliefs, which also suggests that risky behaviours are dictated to a greater extent by people's consideration of positive than negative behavioural attributes. Thus, research on bi-dimensional attitudes implies that interventions need to successfully target both the positive dimension of attitudes (i.e., reduce the extent to which drivers evaluate the positive attributes of speeding as being positive) and the negative dimension of attitudes (i.e., increase the extent to which drivers evaluate the negative attributes of speeding as being negative). That research also implies that interventions should focus to a greater extent on the positive attitude dimension rather than the negative attitude dimension if they are to reduce speeding (i.e., interventions primarily need to reduce the extent to which drivers evaluate speeding as being positive rather than increase the extent to which they evaluate speeding as a negative behaviour).

2.3.2.2 Explicit versus Implicit attitudes

Thus far, the research cited in this thesis has focused exclusively on use of self-reported measures of attitudes in the prediction of behaviour. All the studies cited in the review of social cognition models and bi-dimensional attitudes have used self-reported attitude measures. Self-reported attitude measures tap what are known as explicit attitudes (e.g., Ajzen & Fishbein, 2000). Explicit attitudes are attitudes of which an individual is consciously aware. Consequently, they are held to influence behaviour through a deliberative process, with individuals consciously considering the positive and negative outcomes of a behaviour before engaging in it (e.g., Fazio, 1990a; Fazio & Olson, 2003; Spalding & Hardin, 1999). This raises two potential concerns. First, many real-world behaviours (e.g., speeding), are readily repeatable and are therefore afforded the opportunity to become automatic. This means that spontaneous processes are likely to be involved in the execution of behaviour in addition to more deliberative processes (e.g., Verplanken & Orbell, 2003). Second, since explicit attitudes are typically measured using self-report questionnaires, they are susceptible to various cognitive biases, such as primary and recency effects (Murdock, 1962), affective biases, such as mood congruent memory effects (e.g., Mayer, McCormick, & Strong, 1995), and self-presentation biases, such as self-deception (Gur & Sackeim, 1979) and impression management (Paulhus & Reid, 1991). Implicitly measured attitudes help to overcome these potential problems. This is because implicit attitudes are attitudes of which individuals are *not* consciously aware. Consequently, they are held to influence behaviour through a spontaneous, rather than a deliberative, process. More specifically, they are held to be activated spontaneously when individuals encounter salient cues that are associated with a behaviour. These automatically activated attitudes are then held to exert a biasing effect on an individual, effectively priming (initiating rapidly and without conscious awareness) attitude-congruent behaviour (Fazio, 1990a; Fazio & Olson, 2003). In addition, implicit attitudes are not vulnerable to self-reporting biases because they are measured by performance on cognitive tests, rather than self-report questionnaires (e.g., Banse, Seise, & Zerbes, 2001).

The most commonly employed method for measuring implicit attitudes is the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998; Greenwald, Nosek, & Banaji, 2003 but see Fazio, 2001 for an alternative method). The IAT is a computer-based reaction time task that assesses the strength of associations between "target concepts" (e.g., behaviours) and "attributes" (e.g., evaluations). In a standard, traditional IAT, a target concept (e.g., speeding) is presented on one side of a computer screen and its opposite concept (e.g., complying) is presented on the other side. Each concept is paired with an attribute (e.g., speeding/good; complying/bad). The participants are presented with items in the middle of the screen relating to both the concepts (e.g., illegal or legal) and the attributes (e.g., happy or nasty). The participants' task is to categorise each item into its relevant category as quickly and accurately as possible (e.g., Greenwald et al., 1998). A measure of attitude (e.g., towards speeding) is then derived from the difference in the participants' response latencies (i.e., time taken to categorise items) in 'compatible trials', when the target concept is paired with 'good' and its opposite concept is paired with 'bad', and their response latencies in the 'incompatible trials', when the target concept is paired with 'bad' and its opposite concept is paired with 'good' (Greenwald et al., 1998; Greenwald et al., 2003). The rationale is that faster response latencies in compatible relative to incompatible trials indicate a positive attitude towards the target concept.

As an example, imagine a driver with a positive attitude towards speeding. This driver would be able to more quickly categorise items in an IAT when 'speeding' is paired with 'good' and 'complying' is paired with 'bad' (i.e., the compatible trials) than when 'speeding' is paired with 'bad' and 'complying' is paired with 'good' (i.e., the incompatible trials). This is because his or her pre-existing cognitive association between 'speeding' and 'good' (i.e., his or her positive attitude towards speeding) is facilitating task performance in the compatible trials and inhibiting it in the incompatible trials (e.g., Greenwald et al., 1998). On the other hand, a driver with a negative attitude towards speeding would be able to more quickly categorise items in an IAT when 'speeding' is paired with 'bad' and 'complying' is paired with 'good' than when 'speeding' is paired with 'good' and 'complying' is paired with 'bad'. This is because his or her pre-existing cognitive association between 'speeding' and 'bad' (i.e., his or her negative attitude towards speeding) is facilitating task performance in the incompatible trials and inhibiting it in the compatible trials.

Several studies have demonstrated that implicit attitudes can predict social and health behaviours such as smoking (e.g., Chassin, Presson, Sherman, Seo, & Macy, 2010), binge-drinking (e.g., Houben, Havermans, & Wiers, 2010) and voting (e.g., Friese, Smith, Plischke, Bluemke, & Nosek, 2012). Studies have also shown that implicit attitudes can account for unique variance in behaviour over and above the variance that is accounted for by explicit attitudes (Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Ledesma, Tosi, Díaz-Lázaro, & Poó, 2018; Spence & Townsend, 2007). This includes recent research in the context of driving by Ledesma et al. (2018) in which seatbelt use was predicted by both implicit attitudes (β = 0.30, p = .001) and explicit attitudes (β = 0.25, p = .03). Although further research is needed to test the independent effects of implicit and explicit attitudes in the context of speeding specifically (this issue is addressed in more detail in chapter 4), Hatfield, Fernandes, Faunce, and Job (2008) developed an IAT to measure implicit attitudes towards speeding and asked drivers to drive in a driving simulator through 40, 50, 70 and 80km/h speed limit areas. The average correlation between IAT scores and participants' mean speed in each speed limit area was r=0.26. The average correlation between IAT scores and the percentage of time that the participants spent driving in excess of the speed limit in each speed limit area was r=0.28. These correlations are approaching moderate sized-effects (Cohen, 1992), consistent with the idea that implicit attitudes are important in dictating speeding behaviour, in addition to explicit attitudes as evidenced by the research reviewed earlier in this chapter.

2.3.2.3 Summary of the research on different types of attitude

As the review of the literature in section 2.3.2.1 shows, attitudes have been shown to comprise a positive dimension (e.g., an evaluation of the positive outcomes that are associated with driving faster than the speed limit) and a separate negative dimension (e.g., an evaluation of the negative outcomes that are associated with driving faster than the speed limit). The positive dimension of attitudes has been shown to be a stronger predictor of several behaviours including speeding. This implies that interventions primarily need to reduce the extent to which drivers evaluate speeding as being positive rather than increase the extent to which they evaluate speeding as being negative.

In addition, a distinction has also been made between explicit attitudes (i.e., attitudes of which an individual is consciously aware) and implicit attitudes (i.e., attitudes of which an individual is not consciously aware). While explicit attitudes are measured using self-reported questionnaires, implicit attitudes have typically been measured using IATs. Both explicit and implicit attitudes have been shown to be associated with the performance of several behaviours including speeding behaviour. Also, research on non-speeding behaviours has shown that implicit attitudes predict unique variance in behaviour, over and above explicit attitudes. Although further research is required to test the independent effects of implicit and explicit attitudes on behaviour in the context of speeding, the implication is that interventions may not only need to target explicit attitudes but also implicit attitudes if they are to be successful at changing driver behaviour.

2.4 Attitude-behaviour change

So far, this chapter has shown that attitudes are important in the prediction of behaviour, which implies that attitude-change interventions should have scope to reduce drivers' speeding behaviour (section 2.3.1). In particular, interventions would seem to have scope to reduce speeding if they successfully change both the positive and negative dimensions of attitudes (in particular the positive dimension) and both explicit and implicit attitudes (see section 2.3.2). The next subsection (section 2.4.1) provides a review of studies in which researchers have tested the effects of attitude-change interventions in order to ascertain the extent to which previous research has led to the identification of effective techniques for changing attitudes and reducing speeding behaviour.

2.4.1 Studies of attitude change interventions

Although the predictive validity of attitudes has been well established (see section 2.3.1), there are fewer examples of studies in which interventions have been used in an attempt to manipulate attitudes and test whether any changes in attitudes can generate changes in intentions and behaviour (Hardeman et al., 2002; Sheeran et al., 2016). In the context of driving specifically, this is also the case. A review of the key intervention studies in the context of speeding is shown in Table 2.1.

Table 2.1. Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results[a]
Brijs, Cuenen, Brijs, Ruiter, and Wets (2014)	n=366 young drivers (under 25 years old)	A post-licence education program involving an interactive lecture and classroom-based group discussions about the risks of speeding (designed to change attitudes) and skills training (designed to improve hazard awareness and vehicle handling). The intervention was based on the Goals for Driver Education (GDE) Matrix.	Quasi-experimental design with 2 groups, both of which received the intervention: Group 1 completed a pre-intervention questionnaire (n=150) and a 2-month post-intervention questionnaire (n=72); Group 2 completed an immediate post-intervention questionnaire (n=216) and a 2-month post-intervention questionnaire (n=104). The questionnaires contained the following measures: speeding attitudes and behavioural intentions; beliefs about how often important others exceed the speed limit; perceptions about how much important others would approve of speeding; perceived personal norms about speeding; perceptions of risk; perceived ability to avoid speeding (self-efficacy). Speeding behaviour was not measured.	There was no difference between the pre- and immediate post- intervention measures of attitudes. Although there was a small-sized improvement in behavioural intentions from pre- to immediate post-intervention (d = 0.17), this was attributed to a small-sized (d = 0.16) improvement in the participants perceived ability to avoid speeding and a small sized (d = 0.20) improvement in the participants' perceptions about how often important others exceed the speed limit. There was no difference between the pre-intervention and 2-month post-intervention measures of attitudes or behavioural intentions.

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Cuenen et al. (2016)	n=1362 students (16-17 years old)	A road safety education program for pre-drivers involving a testimonial from a relative of a traffic-crash victim about the victim's life before and after the traffic crash and the circumstances of the crash, followed by a group discussion. The researchers did not state that the intervention was based on theory.	Quasi-experimental design with 2 groups both of which received the intervention: Group 1 completed a pre-intervention questionnaire (n=658) and 2-month post-intervention questionnaire (n=136); Group 2 completed an immediate post-intervention questionnaire (n=704) and a 2-month post-intervention questionnaire (n=141). The questionnaires contained the following measures: speeding attitudes and behavioural intentions; perceptions about how much important others would approve of speeding; perceived ability to avoid speeding; and speeding behaviour.	There was a small sized difference between the pre- and immediate post-intervention measures of speeding attitudes and intentions, for students in general education (*d* = 0.40 and *d* = 0.38 respectively). There were significant, but negligible differences between pre- and immediate post-intervention measures of attitudes, intentions and behaviour, for students in occupational education (*d* = 0.17, *d* = 0.09, and *d* = 0.01 respectively). There was a small sized difference between the pre- and 2-month post-intervention measures of speeding attitudes and behaviour (*d* = 0.34 in both cases), and a moderated sized difference between the pre- and 2-month post-intervention measures of behavioural intentions (*d* = 0.55). These differences were for males only. No changes in attitudes, behavioural intentions or behaviour were found for females.

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Elliott and Armitage (2009)	n=300 driving license holders (mean age 49.20 years old)	An 8-page booklet that included information about the risks of speeding in 30mph areas and persuasive messages designed to change beliefs underpinning the Theory of Planned Behaviour constructs. The intervention was based on the Theory of planned Behaviour.	Randomised control design with 2 groups: an experimental group (n = 141) that received the intervention; a control group (n = 159) that did not receive the intervention. Both groups completed an immediate pre-intervention questionnaire and a 1-month post-intervention questionnaire. The questionnaires contained the following measures: attitudes towards keeping within the speed limit; perceptions about how much important others would approve of keeping within the speed limit; perceived ability to keep within the speed limit; behavioural intentions to keep within the speed limit; and speeding behaviour.	There were no differences between the experimental and control groups on the pre- or 1-month post intervention measures of attitudes or behavioural intentions. There was a small-sized difference between the experimental and control groups on 1-month post-intervention measure of speeding behaviour (d = 0.19) but this was attributed to a small sized post-intervention difference on the measure of perceived ability to keep within the speed limit (d = 0.21).

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Glendon et al. (2014)	n=305 students (16-17-year olds)	A road safety program for pre-drivers involving six 30-minute sessions. This included a local police presentation covering the possible consequences of speeding, such as fatalities, crashes, fines and penalty points. Other sessions involved interacting with someone who had been seriously injured in a crash; a practical demonstration of the importance of vehicle and road conditions on reaction times and stopping distances; an interactive workshop on the impact alcohol, drugs and fatigue has on driving; group discussions about the importance of vehicle safety; talks targeting attitudes and how to minimize distraction and anticipate hazards. The researchers did not state that the intervention was based on theory.	Randomised control design with 2 groups: an experimental group (n = 133) that received the intervention; a control group (n = 172) that did not receive the intervention. Both groups completed an immediate pre-intervention questionnaire, an immediate post-intervention questionnaire and a 6-week post-intervention questionnaire. The questionnaires contained the following measures: attitude towards speeding and other risky driving behaviours; and perceptions about the risks of speeding and other risky driving behaviour. Behavioural intentions to speed and speeding behaviour were not measured.	There were no differences between the experimental and control groups on the pre-, immediate post- or 6-weeks post-intervention measures of attitudes.

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Goldenbeld et al. (2008)	N=81 driving license holders (mean age 51 years old)	A video of a traffic accident (a pedestrian being hit by a car and thrown into the air by the car) and a surgeon explaining the damage to the human body as a result of it. The researchers did not state that the intervention was based on theory. This was accompanied by a neutrally written 4-page leaflet on 60km/h zones, national road safety targets, and the advantages that 60km/h zones can have on road safety and quality of life.	Randomised control design with 4 groups: an experimental group (n = 25) that received both the video and leaflet; an experimental group (n=14) that received the video only; an experimental group (n=25) that received the leaflet only; and a control group (n = 17) that did not receive either the video or leaflet. All groups completed an immediate post-intervention questionnaire. The questionnaires contained the following measures: knowledge about60mk/h zones; the clarity and persuasiveness of the intervention; perceptions about the problem when speeding inside and outside urban areas; attitudes and behavioural intentions to speed in 60km/h zones. Post-intervention speeding behaviour was not measured.	There were no differences between the 4 groups on the measures of speeding attitudes or behavioural intentions.

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Lang, Vandrevala, and McWhirter (2010)	n=42 learner drivers (17-26 years old)	A 2-hour facilitated discussion group. The discussion topics covered the skills needed to be a learner driver, prior learning undertaken, the characteristics of a safe driver and who is most at risk of being involved in a traffic crash. This was accompanied by solo driving skills training (planning how to deal with challenges on the road once they have passed their driving test) and insight training (completing a reaction time task to demonstrate how long it can take to react to a hazard). The intervention was based on the Goals for Driver Education (GDE) Matrix.	Within participants design: Intervention group only (n=42); no control group. The participants completed an immediate pre-intervention questionnaire and an immediate post-intervention questionnaire. The questionnaires contained the following measures: attitudes and behavioural intentions towards a range of risky driving behaviours, including speeding; perceptions about how much important others would approve these driving behaviours; and perceived ability to avoid them (self-efficacy) and behavioural intentions to speed. Speeding behaviour was not measured.	There was no pre- to post-intervention differences in speeding attitudes or behavioural intentions.

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Meadows and Stradling (1999)	n=46 learner drivers (17-25 years old)	A learner driver information pack that consisted of tasks such as imaging they were late for an important meeting and consider what they might do in that situation; and imagining they were involved in a variety of accidents and how they would feel. These tasks were completed between driving lessons. There was also an instructor information pack that informed the instructors of the importance of learners' attitudes towards road safety and provided them with some attitude change techniques (e.g., the arousal of fear through the description of serious, and often horrific accidents). The researchers did not state that the intervention was based on theory.	Randomised control design with 4 groups: an experimental group (n = 10) that received the both the learner and instructor information packs; an experimental group (n=12) that received the learner information pack and a control instructor pack; an experimental group (n=10) that received the instructor resources information pack and a control learner information pack; and a control group (n = 14) that received the control learner and instructor information packs. All groups completed a 1-week pre-intervention questionnaire, an immediate post-intervention questionnaire and a 3-week post-intervention questionnaire. The questionnaires contained the following measures: speeding attitudes and behavioural intentions. Speeding behaviour was not measured.	Pre- to post- intervention 'improvement' measures of speeding attitudes and behavioural intentions were calculated for the 4 groups but between-group differences in these improvement measures were not statistically tested.

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Parker, Stradling, and Manstead (1996)	n=238 (17-40 years old)	A video based intervention depicting a driver experiencing negative outcomes of speeding (e.g., being stopped by the police and fined, causing an accident, and putting pedestrians at risk). The intervention was based on the Theory of planned Behaviour.	Randomised control design: an experimental group (n = 45) received the intervention and a control group (n = 50) did not. All groups completed an immediate post-intervention questionnaire. The questionnaires contained the following measures: attitudes; perceptions about how much important others would approve of speeding; perceived ability to avoid speeding; perceptions about how much regret would be felt following speeding behaviour; behavioural intentions. Post-intervention speeding behaviour was not measured.	There were no differences between the experimental and control groups on the measures of speeding attitudes or behavioural intentions.

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Poulter and McKenna (2010; study 1)	n=199 pre-drivers (15-16 years old)	A live show featuring a video that depicted a fatal car crash involving young people, with the content focusing on the risks of speeding, night driving, overtaking, and peer pressure. The video was interspersed with testimonials from people who had direct experience of road traffic fatalities. The researchers did not state that the intervention was based on theory.	Within participants design: Intervention group only (n=199); no control group. The participants completed a 1-2-week pre-intervention questionnaire, a 1-2-week post-intervention questionnaire and 5-month post-intervention questionnaire. The questionnaires contained the following measures: attitudes and behavioural intentions to drive within the speed limit; behavioural intentions to conform to the Highway code and road traffic laws; the inevitability of exceeding the speed limit occasionally; perceptions about how much important others would approve of speeding; perceived ability to stick to the speed limit; and resist social pressure to speed from friends. Speeding behaviour was not measured.	There was no difference between the pre-and 1-2-week post-intervention measure of attitudes towards driving within the speed limit. There was a small sized difference between the pre- and 1-2-week post-intervention measure of intention to drive within the speed limit ($\omega^2 = 0.03$) but this was attributed to small sized pre- to 1-2-week post-intervention differences in in participants' perceived ability to stick to the speed limit ($\omega^2 = 0.01$) and resist social pressure to speed from friends ($\omega^2 = 0.02$). There were no differences between pre- and 5-month post-intervention measures of speeding attitudes or behavioural intentions.

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Poulter and McKenna (2010; study 2)	n=430 pre-drivers (15-16 years old)	Same as Poulter and McKenna (2010; study 1)	Randomised control design with 2 groups: an experimental group (n = 214) that received the intervention; a control group (n = 242) that did not receive the intervention. Both groups completed a 1-2-week pre-intervention questionnaire, and a 1-2-week post-intervention questionnaire. The questionnaires contained the following measures: attitudes and behavioural intentions to drive within the speed limit; behavioural intentions to conform to the Highway code and road traffic laws; the inevitability of exceeding the speed limit occasionally; perceptions about how much important others would approve of speeding; perceived ability to stick to the speed limit; resist social pressure to speed from friends; perceptions about how susceptible they are to be involved in an accidence; and driving ability. Speeding behaviour was not measured.	There were no differences between the experimental and control groups on the pre- or post-intervention measures of attitudes towards driving within the speed limit. There was a small sized difference between the experimental and control groups on post-intervention measure of behavioural intentions (*d* = 0.31) but this was attributed to small- to moderate- sized post-intervention differences in the participants' perceptions that important others would approve of not exceeding the speed limit (*d* = 0.24), their perceived ability to stick to the speed limit (*d* = 0.27) and resist social pressure to speed from friends (*d* = 0.48); and their perceived susceptibility to road traffic accident involvement (*d* = 0.33).

Table 2.1. (Continued) Review of attitude-change intervention studies in the context of speeding

Reference	Sample	Intervention characteristics	Study characteristics	Relevant results
Stead et al. (2004)	n=550 driving license holders (17-54 years old)	Mass media advertising campaign that consisted of a series of television adverts that were designed to: change drivers' attitudes towards speeding (e.g., an advert showing that speeding does not save drivers much time and that a speeding driver is not in full control of the car); make drivers think that important others would not approve of speeding (e.g., an advert showing that family members do not approve of their speeding behaviour; and make drivers think that they are in control of whether or not they speed (e.g., an advert showing that it is possible to withstand pressures to speed). The intervention was based on the Theory of planned Behaviour.	Within participants design: Intervention group only (n=550); no control group. The participants completed pre-intervention questionnaire (the amount of time prior to the intervention was not stated); a 1-year post-intervention questionnaire, a 2-year post-intervention questionnaire and a 3-year post-intervention questionnaire. The questionnaires contained the following measures: speeding attitudes and behavioural intentions; perceptions about how much important others would approve of speeding; perceived ability to avoid speeding; and speeding behaviour.	There were significant, but negligible (i.e., less than small effect size) differences between the pre- and 1-year post intervention measures of attitudes (d = 0.10) and the pre- and 2-years post-intervention measures of attitudes (d = 0.11). There was no difference between the pre- and 3-year post-intervention measures of attitudes. There were no differences between the pre- and any of the post-intervention measures of behavioural intentions or speeding behaviour.

Note: In the social sciences, d = 0.20 and ω^2 = 0.01 are conventionally accepted as small-sized effects, d = 0.50 and ω^2 = 0.06 are conventionally accepted as moderate-sized effects, and d = 0.80 and ω^2 = 0.14 are conventionally accepted as large-sized effects (Cohen, 1992; Field, 2013).

[a] Given the research reported in this thesis focuses on attitude- and behaviour-change, the results from the previous intervention studies are reported if they relate to a potential intervention effect on the measures of attitudes towards speeding, speeding behaviour or a proxy for speeding behaviour (e.g. behavioural intentions). Potential intervention effects on other measured constructs are not described unless they help account for any potential intervention effects on the measures of speeding behaviour or proxies for speeding behaviour.

It can be seen from Table 2.1 that previous intervention studies have focused on a range of different types of driver. For example, interventions to change attitudes towards speeding have focused on pre-drivers (e.g., Cuenen et al., 2016; Glendon et al., 2014; Lang et al., 2010; Meadows & Stradling, 1999; Poulter & McKenna, 2010), young drivers (Brijs et al., 2014) and general population drivers (e.g., Elliott & Armitage, 2009; Goldenbeld et al., 2008; Parker et al., 1996; Stead et al., 2004). It can also be seen that different intervention techniques have been used across the various studies including information booklets, educational videos, testimonials from victims of road traffic crashes, mass media campaigns and group discussions, all of which were designed to make drivers aware of the risks of speeding and how to drive more safely.

Overall, as can be seen in Table 2.1, the interventions tested in previous studies have typically led to no changes in drivers' attitudes towards speeding or small-sized changes according to conventionally accepted criteria in the social sciences (Cohen, 1992). Additionally, when attitude-change has been found, researchers have usually measured attitudes immediately following intervention (Lang et al., 2010). In studies where interventions have been tested over a longer period of time (e.g., 1+ months), no changes in attitudes have typically been found (e.g., Elliott & Armitage, 2009; Poulter & McKenna, 2010: study 1). Exceptions to these findings tend to come from studies that suffer methodological limitations such as the use of within-subjects or quasi-experimental designs (i.e., no control groups) and small samples, meaning that tests of statistical significance have not been conducted (e.g., Cuenen et al., 2016; Meadows & Stradling, 1999; Stead et al., 2004). Additionally, the control groups that have been employed in the previous controlled experiments in Table 2.1 (e.g., Elliott & Armitage, 2009; Poulter & McKenna, 2010: study 2) have been passive (i.e., the control participants have not been given any form of intervention). This means that any changes in drivers' attitudes, or changes in any other measured construct, could be attributable to demand characteristics rather than the intervention that is delivered to the experimental group (Rosenthal & Jacobson, 1966). The limited evidence for attitude-change from the studies in Table 2.1 must therefore be treated with caution.

The studies in Table 2.1 have also provided limited evidence about the extent to which previous attitude-change interventions have generated reductions in speeding behaviour. One reason is that many studies have not included measures of speeding behaviour (e.g., Brijs et al., 2014; Glendon et al., 2014; Goldenbeld et al., 2008; Lang et al., 2010; Meadows & Stradling, 1999; Parker et al., 1996; Poulter & McKenna, 2010). Another reason is that, in other studies, behavioural intentions have been measured in order to gauge the likely impact of the interventions on speeding behaviour (e.g., Brijs et al., 2014; Cuenen et al., 2016; Elliott & Armitage, 2009; Goldenbeld et al., 2008; Lang et al., 2010; Meadows & Stradling, 1999; Parker et al., 1996; Poulter & McKenna, 2010). However, behavioural intentions are not ideal proxies for behaviour (e.g., Armitage & Conner, 2001), meaning that changes in behavioural intentions may not translate into reductions in speeding. Additionally, in the studies where statistically significant changes in speeding intentions (e.g., Brijs et al., 2014; Cuenen et al., 2016; Elliott & Armitage, 2009; Poulter & McKenna, 2010) or behaviour (Cuenen et al., 2016; Elliott & Armitage, 2009) have been found, researchers have tended to deploy interventions that target a range of socio cognitive constructs (e.g., perceived ability to avoid speeding, perceptions of whether important social referents would approve of speeding) or driving related skills (e.g., hazard awareness, vehicle handling skills) in addition to attitudes. In these studies, the observed changes in speeding intentions or behaviour have occurred because the interventions changed those other constructs, not attitudes (see Table 2.1). Given that attitudes have typically been demonstrated to be stronger predictors of behaviour compared to other social cognitive constructs (see section 2.3), it is likely that larger reductions in speeding behaviour could be achieved if interventions could successfully change attitudes.

Overall, it can be seen from the review in Table 2.1 that previous research has not demonstrated convincingly that attitude-change interventions have been successful at generating changes in drivers' speeding attitudes or behaviour. Possible reasons for why the intervention techniques used in previous studies have not been found to generate these desired changes are considered in the following subsections along with the implications for how interventions might successfully change attitudes and reduce speeding.

2.4.2 Possible reasons for the apparent ineffectiveness of attitude-change interventions and the implications for future research

In this subsection, the following possible reasons are considered for why the interventions that have been tested in previous studies have not been found to generate much change in attitudes or speeding behaviour: (1) the interventions have tended to be based on intuition rather than psychological theory; (2) they have tended to focus on changing attitudes through the provision of indirect (second-hand) experience; (3) they have tended to focus on changing the negative dimension of attitude at the expense of the positive dimension; (4) they have not targeted both explicit and implicit attitudes; and (5) they have not taken into account that not all drivers behave in accordance with their attitudes.

2.4.2.1 Intuition-based rather than theoretically-based interventions

As several authors have noted (Fylan & Stradling, 2014; Helman, Ward, Christie, & McKenna, 2011) the content of attitude-change interventions tends to be based on researchers' intuition, or common-sense assumptions, rather than theory. In line with these observations, it can be seen in Table 2.1 that very few interventions are reported to be based on theory. Interventions based on common sense assumptions about what might change drivers' attitudes are unlikely to be successful at generating changes in attitudes and reductions in speeding behaviour because common sense assumptions are often found to be incorrect (e.g., Kelly & Barker, 2016; Van Der Vleuten, Dolmans, & Scherpbier, 2000). On the other hand, theoretically-based interventions are likely to be more successful at changing attitudes and reducing speeding behaviour because they are based on established principles of attitude and behaviour change (e.g., Davis, Campbell, Hildon, Hobbs, & Michie, 2015; Michie, Fixsen, Grimshaw, & Eccles, 2009; Michie, Johnston, Francis, Hardeman, & Eccles, 2008; Michie & West, 2013; N. J. Taylor, Conner, & Lawton, 2012). Intervention techniques that are grounded in psychological theory are therefore likely to be needed to change drivers' attitudes towards speeding and reduce speeding behaviour.

2.4.2.2 Indirect rather than direct experience

As discussed in the previous section (section 2.4.1), the intervention techniques that have been tested in previous intervention studies include information booklets, educational videos, testimonials from victims of road traffic crashes and group discussions. Consistent across all these intervention techniques, therefore, is the idea that the provision of second-hand information (e.g., about the risks of speeding) is sufficient to generate a change in drivers' attitudes, which in turn will generate a reduction in speeding behaviour.

The proposition that second-hand information is sufficient to generate a change in attitudes and concordant behaviour is at odds with the literature on attitude formation (e.g., Glasman & Albarracin, 2006). The literature on attitude formation shows that attitudes based on indirect experiences (i.e., second-hand information) tend to be 'weak' attitudes. Weak attitudes tend to be unstable over time, not very accessible in memory, high in ambivalence, low in affective-cognitive consistency, and not held with much certainty or importance (e.g., Glasman & Albarracin, 2006; Kraus, 1995). On the other hand, attitudes based on direct experiences (i.e., first-hand information) tend to be 'strong' attitudes. Strong attitudes tend to be stable over time, highly accessible in memory, low in ambivalence, high in affective-cognitive consistency, and held with certainty and importance (e.g., Glasman & Albarracin, 2006; Kraus, 1995). Importantly, measures of attitude stability (e.g., Davidson & Jaccard, 1979; Doll & Ajzen, 1992; Fazio & Zanna, 1978), accessibility (e.g., Elliott, Lee, et al., 2015), ambivalence (e.g., Conner et al., 2002; M. Moore, 1980; Sparks, Conner, James, Shepherd, & Povey, 2001), affective-cognitive consistency (e.g., Norman, 1975), certainty (e.g., Warland & Sample, 1973) and importance (e.g., Krosnick & Schuman, 1988) have all been found to moderate the attitude-behaviour relationship. In each case, attitudes that contain the properties of attitude strength have been found to be stronger predictors of behaviour (for a review see Glasman & Albarracin, 2006; Kraus, 1995). These studies have also provided direct evidence that attitudes based on direct experience are better predictors of behaviour than are attitudes based on indirect experience. Previous research on attitude formation therefore implies that interventions that rely on the use of second-hand information (e.g., the interventions summarised in Table 2.1) will generate only weak attitudes that are unlikely to lead to a change in behaviour. On the other hand, interventions that tap into direct, first-hand experiences are likely to be more successful at generating attitude- and behaviour- change because they are likely to lead to the formation of stronger attitudes.

Additionally, existing attitudes towards speeding are, on average, likely to be highly established because the dynamics of the driving task dictate that drivers' choices about how fast to drive need to be made on a moment-by-moment basis every time the vehicle is in motion. As a result, speeding is the sort of behaviour that can be readily repeated, meaning that the outcomes of speeding can be experienced directly by drivers on a regular basis. This is important because the driving environment is largely forgiving, with drivers being able to exceed the speed limit without often experiencing a negative outcome, such as being caught by the police. On the other hand, positive outcomes such as getting to one's destination more quickly, are more commonly experienced (e.g., Fuller et al., 2009; Gabany, Plummer, & Grigg, 1997). Direct experience of positive outcomes at the expense of negative outcomes therefore means that pro-speeding attitudes are likely to be strongly held. An intervention that attempts to use indirect experience (e.g., telling drivers that many [other] drivers have experienced a traffic crash due to speeding) is therefore unlikely to have much scope to override what a driver has learned from direct experience. On the other hand, an intervention that aims to change attitudes using newly acquired direct experiences might have more scope to change attitudes and behaviour.

2.4.2.3 Focus on the negative rather than positive dimension of attitude

The interventions summarised in Table 2.1 have tended to focus exclusively on the negative outcomes of speeding (e.g., through providing information about fatal car crashes or other risks associated with speeding, or testimonials from the victims of traffic crashes and their relatives). Given the literature on bi-dimensional attitudes reviewed in section 2.3.2.1, showing that attitudes comprise two separate, positive and negative dimensions, it seems reasonable to assume that these interventions are likely to target the negative attitude dimension, rather than the positive attitude dimension. In other words, they seem well equipped to increase the extent to which drivers evaluate speeding negatively rather than decrease the extent to which they evaluate speeding positively. However, no studies in Table 2.1 measured bi-dimensional attitudes, which means that the potential effects of the interventions on the separate attitude dimensions are unknown. Perhaps more important is that the evidence reviewed in section 2.3.2.1 showed that the positive dimension of attitudes is a better predictor of behaviour than the negative dimension. Thus, the interventions summarised in Table 2.1 are likely to target the dimension of attitude that is the least predictive of behaviour. In line with the evidence reviewed in section 2.3.2.1, an intervention that aims to primarily target the positive attitude dimension may have more scope to decrease speeding. More generally, an evaluation of any intervention that seeks to reduce speeding by changing drivers' attitudes should measure the intervention's effects on both the positive and negative attitude dimensions in addition to speeding behaviour.

2.4.2.4 Implicit attitudes

The attitude-change interventions in Table 2.1 are all based on the principles of persuasion (i.e., convincing drivers that they need to change their attitudes based on information about the risks of speeding that is provided through leaflets or advertisements, discussions or testimonials). According to models of persuasion (e.g., heuristic-systematic model; elaboration likelihood model), people need to consciously attend to and cognitively process the information that is given to them in an attempt to change their attitudes for lasting attitude-change to occur (e.g., Chaiken, 1980, 1987; Chaiken, Liberman, & Eagly, 1989; Petty & Cacioppo, 1986). Evidence to support this proposition comes from studies showing that there is a correlation between the number of consciously generated cognitive responses (thoughts) that participants have about persuasive messages and the extent to which their attitudes subsequently change (e.g., Petty & Cacioppo, 1979, 1984; Petty, Cacioppo, & Goldman, 1981).

Given that persuasion relies on the conscious, cognitive processing of information, a possible explanation for the apparent lack of attitude-change that has been found in the studies summarised in Table 2.1 is that the participants did not sufficiently process the required information. However, this explanation seems unlikely to account for the lack of evidence across all the studies in Table 2.1. In particular, Parker et al. (1996) measured the number of cognitive responses that the participants generated about the messages contained in their intervention. The participants who received the attitude-change intervention generated 42 anti-speeding thoughts, compared to only 8 pro-speeding thoughts, which shows that the participants cognitively processed the relevant information. However, still no attitude change was found. The other explanations, discussed above, therefore seem to provide a more plausible explanation for why the interventions in Table 2.1 might have been generally ineffective at changing attitudes.

However, an explanation for why the persuasive interventions summarised in Table 2.1 might not have generated reductions in speeding behaviour is that conscious, cognitive processing (persuasion) is well-equipped to alter explicit (conscious) attitudes rather than implicit (subconscious) attitudes. Although further research is required in the specific content of speeding, the literature reviewed in section 2.3.2.2 shows that both explicit and implicit attitudes can predict behaviour, implying that interventions may need to tap into both conscious and subconscious processes in order to change both types of attitude and reduce speeding. Indeed, intervention techniques that tap subconscious processes, such as evaluative conditioning (e.g., Olson & Fazio, 2006), or approach/avoidance training (e.g., Wiers, Rinck, Kordts, Houben, & Strack, 2010) are known to be effective at changing behaviour in the domains of racial prejudice and alcohol dependency. No research has tested the effects of such implicit interventions in the context of speeding behaviour, however.

2.4.2.5 Attitude-behaviour discrepancies

The research reviewed in section 2.3.1 shows that attitudes are good predictors of speeding behaviour. However, it is clear that the same research evidence also shows that attitudes are not perfect predictors of behaviour. More specifically, research conducted within the frameworks of the Theories of Reasoned Action and Planned Behaviour, the Prototype Willingness Model and the MODE model show that while attitudes account for a substantial proportion of the variance in behavioural intentions, behavioural willingness or behaviour, there is a substantial proportion of variance that is not accounted for. In other words, there is a large degree of consistency between speeding attitudes and speeding behaviour, with many drivers exceeding speed limits, in line with their positive (socially undesirable) attitudes towards this behaviour. However, there is also a considerable degree of discrepancy between speeding attitudes and speeding behaviour, with many other drivers exceeding speed limits in spite of their negative (socially desirable) attitudes towards this behaviour. In support of this proposition, a re-analysis of data collected by McCartan et al. (2018) showed that 50.8% of drivers who regularly exceeded the speed limit (operationally defined as exceeding the speed limit more often than the average [median] driver in the sample) also stated that they had positive attitudes towards speeding but the remaining 49.2% of drivers who regularly exceeded the speed limit stated they had negative attitudes towards this behaviour. These findings are in line with related research into the sources of consistency and discrepancy between behavioural intentions and subsequent behaviour in the context of speeding (e.g.,Elliott & Armitage, 2006) and other health behaviours (Orbell & Sheeran, 1998; Sheeran, 2002), in which just under half of participants who perform risky behaviours report prior intentions to do so and just over half do not.

Research on attitude-behaviour consistency and discrepancy therefore implies that only around a half of speeding motorists need an intervention to alter their attitudes. However, in the studies summarised in Table 2.1, attitude-change interventions have been tested using samples drawn from general populations of students or the wider public without any prior screening of participants' attitudinal profile. This means that while interventions have been tested using samples that include many drivers with positive attitudes towards speeding, which need changing from a road safety perspective, they include many other drivers with negative attitudes, which do not need changing. While this is common practice in health intervention research more generally (e.g., Portnoy, Scott-Sheldon, Johnson, & Carey, 2008; Webb, 2006; Webb, Joseph, Yardley, & Michie, 2010), it is problematic because it unduly limits the extent to which interventions have scope to change attitudes and behaviour and therefore provides an unfair test of intervention effectiveness. For this reason, the effectiveness of an intervention is usually judged on in other areas of psychology and other disciplines by the extent to which it affects the outcomes of participants who were appropriate for the intervention in the first place. For example, evidence for the effectiveness of pedestrian road crossing and decision-making skill training tends to come from studies of children, who need to develop the required skills (e.g., Foot et al., 2006; Thomson et al., 2005). Similarly, in the field of medicine (e.g., Reichard, Nilsson, & Rosenqvist, 1993; Weng et al., 2008), evidence for the effectiveness of drug treatments (e.g., insulin injections for controlling type 1 or 2 diabetes) comes from trials of patients with the relevant condition (e.g., type 1 or 2 diabetes). Screening procedures therefore need to be employed in the present context to ensure that the samples used in attitude intervention research include only speeders who have positive attitudes towards speeding (i.e., people whose behaviour needs changing and for whom there is scope to make attitudes more desirable from a road safety perspective).

Related to this point, the above cited research on attitude-behaviour consistency and discrepancy implies that while attitude-change interventions are needed for many drivers in an attempt to reduce speeding behaviour (i.e., speeders with positive attitudes towards speeding), a different type of intervention is needed for many other drivers (i.e., those who already have negative attitudes towards speeding). More specifically, drivers with negative attitudes towards speeding need an intervention to help them convert their generally ‘safe’ attitudes into behaviour (compliance with speed limits). As is the case for attitude-change interventions, these ‘attitude-conversion’ interventions need to be tested using samples of drivers who are appropriate (in this case, speeders with negative attitudes towards speeding).

2.5 Conclusions

To conclude, the literature reviewed in this chapter shows that attitudes are a key predictor of behaviour through both reasoned decision-making processes as well as reactive, or automatic, decision-making processes. Attitudes have consistently been found to predict behaviour for various social and health behaviours, including speeding. In addition, attitudes have also been shown to comprise a positive dimension (evaluations of the positive outcomes that are associated with driving faster than the speed limit) and a negative dimension (evaluations of the negative outcomes that are associated with driving faster than the speed limit). The positive dimension of attitudes has been demonstrated to be a stronger predictor of behaviour, including speeding, compared to the negative dimension of attitudes. A distinction has also been made between explicit attitudes (i.e., attitudes of which an individual is consciously aware) and implicit attitudes (i.e., attitudes of which an individual is not consciously aware). Although further research is required to test the independent effects of explicit and implicit attitudes in the context of speeding specifically, explicit and implicit attitudes have been shown to be associated with this behaviour. Overall, there seems scope to modify speeding behaviour through attitude-change, particularly if interventions can change the positive dimension of drivers' attitudes more so than the negative dimension and if they can change both explicit and implicit attitudes.

However, the research on attitude-change interventions reviewed in this chapter has shown that previous efforts to change drivers' attitudes have not been very successful. Possible reasons for the apparent ineffectiveness of previous attitude-change interventions are that: interventions are typically based on intuition rather than theory; passive learning techniques that provide drivers with indirect experience of the (mainly) negative outcomes of speeding are used to convince drivers to change their attitude; techniques to influence both explicit and implicit are not employed; and studies tend to test the effects of interventions on the attitudes and behaviour of samples that are likely to include a high proportion of drivers who do not require the intervention in the first place and instead require an intervention to help them convert their already existing, generally 'safe' attitudes into behaviour (avoidance of speeding). The implication is that research is needed to develop theoretically-based interventions that provide drivers with a direct experience, which has the scope to engender lasting attitude change. Such interventions are likely to need to target the positive dimension of attitudes (i.e., reduce the extent to which drivers evaluate the positive attributes of speeding as being positive) in addition to the negative dimension of attitude (i.e., increase the extent to which drivers evaluate the negative attributes of speeding as being negative). They may also need to change implicit attitudes in addition to explicit attitudes. In addition, different kinds of interventions are needed to reduce speeding for different kinds of drivers, with attitude-change interventions being needed for drivers with positive (socially undesirable) attitudes towards speeding and attitude-conversion interventions being needed for drivers with negative (socially desirable) attitudes. Finally, research testing the effectiveness of these interventions needs to focus on samples of drivers who are appropriate for each type of intervention.

A theory that is well equipped to provide a basis for the development of attitude-change and attitude conversion interventions, which tap into direct experience in order to generate attitude or behaviour change is cognitive dissonance theory. This theory will therefore be reviewed in the next chapter (chapter 3).

Chapter 3: Cognitive dissonance theory

3.1 Chapter Summary

This chapter describes cognitive dissonance theory in order to demonstrate that the theory is well equipped to address the aims of this thesis. It provides the background to the theory of cognitive dissonance, as well as a review of the induced compliance paradigm, an attitude-change intervention, and the hypocrisy induction paradigm, an attitude-conversion intervention. This chapter also discusses how these cognitive dissonance inducing intervention are able to address the aims of this thesis.

3.2 Introduction

As highlighted in chapter 2, attitudes have been found to be key predictors of drivers' speeding behaviour, implying that there is scope to reduce speeding through interventions that modify attitudes. However, the research on attitude-change interventions that was reviewed in chapter 2 showed that previous efforts to change drivers' attitudes have not been very successful at generating attitude- or behaviour-change. Reasons for the apparent lack of effectiveness of previous attitude-change interventions were explored, leading to the conclusion that interventions based on psychological theory are needed to engender attitude- and behaviour-change. In addition, it was concluded that these interventions need to provide drivers with direct rather than indirect experience in order to engender lasting attitude-change that influences behaviour. They also need to target the positive dimension of attitudes (i.e., reduce the extent to which drivers evaluate the positive attributes of speeding as being positive) more so than the negative dimension (i.e., increase the extent to which drivers evaluate the negative attributes of speeding as being negative) and both explicit (conscious) and implicit (non-conscious) attitudes. Finally, it was concluded that different kinds of interventions are needed to reduce speeding for different kinds of drivers, with attitude-change interventions being needed for drivers who speed in line with their positive (i.e., unsafe) attitudes towards speeding and attitude-conversion interventions being needed for drivers who speed in spite of their negative (i.e., generally safe) attitudes towards speeding.

Therefore, as a theory was required which would be well equipped to provide a basis for the development of attitude-change *and* attitude conversion interventions, this ruled out using theories that focused on either attitude-change or attitude-conversion, and ruled out theories that did not focus on attitudes. For example, the elaboration likelihood model (Petty and Cacioppo, 1980) focuses on persuasion and is therefore relevant for attitude-change interventions. However, this model is not relevant for attitude-conversion interventions as those who need an attitude-conversion intervention do not need persuading that speeding is negative, as they already hold that view. In addition, a theory was required which could provide a technique to tap into direct experience in order to generate attitude and behaviour change, as direct experiences are more likely to generate attitude-change, as opposed to indirect experience (see chapter 2). Therefore, this ruled out using theories that could not address this aim. For example, the Behaviour Change Wheel (Michie, Stralen & West, 2011) identified 9 intervention functions that can be used to change either capacity to engage in a behaviour, opportunity that makes a behaviour possible, or motivation to perform a behaviour. Although the intervention functions may be appropriate for attitude-change interventions (e.g., education, persuasion, and restrictions) and attitude-conversion interventions (e.g., incentivisation, training, and enablement), the framework lacks a function that could tap into a direct experience in order to generate attitude and behaviour change.

A theory that is well equipped to provide a basis for the development of attitude-change *and* attitude conversion interventions, which tap into direct experience in order to generate attitude or behaviour change is cognitive dissonance theory. This chapter will provide an overview of cognitive dissonance theory in order to demonstrate why this is an appropriate theory on which to base attitude-change and attitude-conversion interventions (section 3.3). The induced compliance paradigm, which is a cognitive dissonance inducing technique that can generate attitude-change, and the hypocrisy induction paradigm, which is a cognitive dissonance inducing technique that can be used to convert attitudes into behaviour, will be reviewed (sections 3.4 and 3.5 respectively). Evidence for the effectiveness of induced compliance and hypocrisy induction interventions from previous studies will also be reviewed. Potential limitations with previous research and a consideration of how induced compliance and hypocrisy induction interventions address the issues raised in chapter 2 will also be discussed (section 3.6).

3.3 What is cognitive dissonance?

Cognitive dissonance (Festinger, 1957) is an unpleasant state of arousal (e.g., feeling discomfort/uneasiness) that is experienced when people hold conflicting attitudes or beliefs or when they realise they have behaved in a manner that is inconsistent with their attitudes. Festinger (1957) argues that individuals strive for cognitive consistency (e.g., consistency between their attitudes and behaviours) and, as a result, they are motivated to reduce any feelings of cognitive dissonance in order to maintain a state of internal consistency. To reduce feelings of cognitive dissonance, the theory proposes that people must change either their attitudes or behaviour, thereby achieving a consistency between their cognitions and actions. Interventions that engender cognitive dissonance can therefore, in theory, be used to alter either attitudes or behaviour. Within the literature on cognitive dissonance, there are two key paradigms that are relevant with regards to this issue: the induced compliance paradigm and the hypocrisy induction paradigm. These two paradigms are described in the following subsections to ascertain how they can be used to reduce speeding behaviour for drivers with positive, or socially undesirable, attitudes towards speeding (i.e., attitude-change interventions) and drivers with negative, or socially desirable, attitudes towards speeding (i.e., attitude-conversion interventions).

3.4 Induced compliance paradigm

The induced compliance paradigm (Festinger & Carlsmith, 1959) provides an intervention technique that can be used to change people's attitudes. Participants are asked to complete a 'counter-attitudinal advocacy task', which requires them to perform a behaviour that is inconsistent with their current attitudes (e.g., a driver who currently speeds and who holds a positive [i.e., unsafe] attitude towards speeding [e.g. "speeding is beneficial"] could be given a counter-attitudinal advocacy task that requires them to argue that speeding is not beneficial). The discrepancy between the participants' attitudes and the performed counter-attitudinal behaviour is theorised to result in feelings of dissonance (Festinger & Carlsmith, 1959). Since the participants cannot go back in time and change their counter-attitudinal behaviour, it is proposed that they will reduce the resulting dissonance by changing their attitudes, bringing them in line with the performed counter-attitudinal behaviour (e.g., the aforementioned driver would be motivated to adopt a less positive attitude or a negative attitude towards speeding). That attitude change is then predicted to generate a change in subsequent behaviour (e.g., the aforementioned driver would be expected to decrease their speeding behaviour). The induced compliance paradigm, therefore, provides a technique that can potentially be used to help encourage attitude-change, thereby reducing subsequent speeding behaviour.

Previous studies have shown that induced compliance interventions can be effective at changing attitudes. In a seminal study by Festinger and Carlsmith (1959), the participants were asked to complete two experimental tasks: one that involved putting 12 spools onto a tray, emptying the tray, refilling it again and repeating the task for 30 minutes; and another that involved turning 48 square pegs on a board for 30 minutes. These tasks were purposely designed to be monotonous so that the participant would develop a negative attitude towards completing them. After completing the tasks, the experimenter told the participants that there were two groups in the experiment. The participants were told that the people in the first group were completing the experimental tasks without any prior introduction but the people in the second group were completing the tasks after being told by a research assistant, pretending to be a participant who had just taken part in the experiment, that the tasks were enjoyable and they had a lot of fun completing them. All of the participants were told they were in the first group. The participants who were randomised to the experimental (counter-attitudinal advocacy task) condition (n= 20 students) were told that the research assistant had not turned up for work. These participants were asked if they would fulfil the job of the research assistant in exchange for $1. The participants who were randomised to the control condition (n= 20 students) were not asked to perform this counter-attitudinal advocacy task. All of the participants were then asked to take part in an interview about what they thought about the experiment in order to determine their attitude towards the experimental tasks. The participants in the experimental condition reported more positive attitudes towards the experimental tasks (i.e., attitudes that were consistent with their behaviour in the counter-attitudinal advocacy task) than did the participants in the control condition. The results demonstrated, therefore, that a counter-attitudinal advocacy task can generate attitude-change, consistent with the theoretical proposition underlying the induced compliance paradigm.

Several studies have supported (Festinger & Carlsmith, 1959)'s findings (e.g., Becker et al., 2010; Stice, Marti, Spoor, Presnell, & Shaw, 2008; Stice, Rohde, Gau, & Shaw, 2009; Stice, Shaw, Becker, & Rohde, 2008). However, there are several factors that have been found to dictate whether asking participants to perform a counter-attitudinal advocacy task generates attitude-change. More specifically, previous research shows that induced compliance interventions can be successful at changing attitudes to the extent that motivation to complete the counter-attitudinal advocacy task cannot be attributed to receiving an incentive or having no choice, to the extent that any feelings of discomfort after performing the counter-attitudinal advocacy task are attributed internally (i.e., to cognitive dissonance) rather than externally ('arousal misattribution'), and to the extent that counter-attitudinal behaviour is performed publicly, rather than privately.

With regard to incentives, Festinger and Carlsmith (1959) included a second experimental condition in their above-mentioned study. The participants in this second experimental condition (*n*= 20 students) underwent the same procedure as those in the above-mentioned experimental condition, with the exception that they were given $20 for completing the counter-attitudinal advocacy task, rather than $1. Unlike the results discussed above, the participants who were given $20 did not report more positive attitudes towards the experimental tasks than did the participants in the control condition. Festinger and Carlsmith (1959) argued that this was because these participants could explain away their behaviour in the counter-attitudinal advocacy task. In other words, these participants had adequate justification (i.e., a large sum of money) for telling the next participant that the task was enjoyable, even though it was not. On the other hand, it was argued that the participants who were given just $1 did not have adequate justification for their behaviour in the counter-attitudinal advocacy task. As a result, it was suggested that the counter-attitudinal behaviour generated cognitive dissonance which motivated attitude-change (for further empirical evidence from studies of incentives see Holms & Strickland, 1970; Linder, Cooper, & Jones, 1967; Preiss & Allen, 1998).

With regard to free choice, Harmon-Jones, Gerdjikov, and Harmon-Jones (2008), asked participants (*n*= 50 students) to perform a counter-attitudinal advocacy task that involved writing essays in favour of increasing tuition fees by 10% the following year. The participants were randomised to either a no-choice condition, where they were told that they had been randomly assigned to write an essay in favour of increasing tuition fees, or a choice condition, where they were told that writing an essay in favour of increasing tuition fees was voluntary. After completing the counter-attitudinal advocacy task, all of the participants were asked to complete a questionnaire, which measured their attitudes towards increasing tuition fees. The participants in the choice condition reported more positive attitudes towards increasing tuition fees (i.e., attitudes that were consistent with the freely chosen counter-attitudinal behaviour), than did the participants in the no-choice condition. The results demonstrated, therefore, that a counter-attitudinal advocacy task will generate attitude-change to the extent that participants have free choice over whether or not they complete it. On the other hand, when participants do not freely choose to perform the counter-attitudinal advocacy task, it provides justification for any counter-attitudinal behaviour (for further empirical evidence from studies of free choice see J. Cooper, Zanna, & Taves, 1978; Linder et al., 1967; Losch & Cacioppo, 1990; Zanna & Cooper, 1974).

With regard to 'arousal misattribution', any feelings of discomfort after performing a counter-attitudinal advocacy task need to be attributed internally rather than externally. For example, in a study by Joule and Martinie (2008), the participants (*n*= 97 students) were asked to complete a counter-attitudinal advocacy task that required them to write arguments in favour of selective admission to university. The participants were randomised to either an 'ultrasound' condition or a 'no ultrasound' condition. In the ultrasound condition, the participants were told that ultrasound waves were being emitted in the experimental room (i.e., they were given a possible external cause that could be used to explain any feelings of discomfort that they might experience during the counter-attitudinal advocacy task). In the no ultrasound condition, the participants were asked to complete the counter-attitudinal advocacy task only (i.e., they were given no possible external cause, meaning that any feelings of discomfort needed to be attributed internally). In line with the idea that a counter-attitudinal advocacy task produces attitude-change to the extent that participants cannot attribute any feelings of cognitive dissonance to an external factor, the participants in the no ultrasound condition had more favourable attitudes towards selective admission to university compared to the participants in the ultrasound condition (for further empirical evidence from studies of arousal misattribution see Fazio & Cooper, 1983; Zanna & Cooper, 1974).

With regard to public versus private advocacy, it is more difficult for a participant to revoke counter-attitudinal arguments when those arguments are made publicly. On the other hand, when counter-attitudinal arguments are not made public, they are easier to retract because they have not been exposed to others. In a study by Leippe and Eisenstadt (1994) the participants (*n*= 64 students who were white) were asked to complete a counter-attitudinal advocacy task that required them to write essays endorsing a policy for increasing scholarship funds for students who were black at the expense of students who were white. All the participants were told that their essay would be send to a panel for review. The participants randomised to a high public advocacy condition were asked to sign and write their student identification and telephone numbers on their essay before sending it to the review panel. The participants randomised to a low public advocacy condition were not asked to do this (i.e., they were told that their essays would be sent to the review panel anonymously). In line with the proposition that a counter-attitudinal advocacy task produces attitude-change to the extent that participants publicly perform the counter-attitudinal advocacy task, the participants in the high-public advocacy condition reported more positive attitudes towards the policy, than did the participants in the low- public advocacy condition (for further empirical evidence from studies of public versus private advocacy see Baumeister & Tice, 1984; Frey & Irle, 1972; Green, Scott, Diyankova, Gasser, & Pederson, 2005).

The above cited research therefore shows that induced compliance interventions can generate attitude-change. Previous research also shows that induced compliance interventions can change subsequent behavioural intentions and behaviour. For example, Simmons and Brandon (2007) tested an induced compliance intervention designed to reduce smoking. The participants (*n*=215 college student smokers) were randomised to: an experimental condition or one of two control conditions. In the experimental condition, the participants were asked to perform a counter-attitudinal advocacy task that required them to discuss smoking-related topics and prepare and film an antismoking video. In the first control condition, the participants were, instead, asked to discuss nutrition-related topics and prepare and film a nutrition-related video. In the second control condition, the participants were shown an antismoking video and then asked to complete a question and answer session about the video with the experimenter. Simmons and Brandon (2007) found that the participants in the experimental condition reported greater post-test intentions to quit smoking and took more antismoking educational pamphlets when leaving the laboratory compared to the participants in both control conditions.

Similarly, (Di Bello, Carey, & Cushing, 2018) tested an induced compliance intervention designed to reduce risky alcohol consumption. The participants (*n*=49 heavy drinking students) were randomised to either an experimental condition or a control condition. In the experimental condition, the participants were asked to perform a counter-attitudinal advocacy task that required them to list reasons why they should avoid alcohol consumption (e.g., hangover) and how students like themselves could avoid these problems, before discussing their response with a researcher. In the control condition, the participants were given the same task but instead of focusing on alcohol, it focused on unhealthy-food consumption. Di Bello et al. (2018) found that the participants in the experimental condition intended to drink less over the next month and reported consuming fewer drinks per week, one month later, than did the participants in the control condition.

In addition, a small number of studies have demonstrated that induced compliance interventions can change both attitudes *and* subsequent behaviour and that the resulting attitude-change is responsible for the subsequent behaviour-change (i.e., attitude change → behaviour change). For example, a study by Stice, Presnell, Gau, and Shaw (2007) tested an induced compliance intervention designed to change participants' (*n*=238 adolescent females) attitudes towards the 'thin-ideal' (i.e., the perception that an ideal woman should have a slender, feminine physique with a small waist and little body fat) and eating disorder behaviours (e.g., dieting, excessive exercise, self-induced vomiting). The participants were randomised to either an experimental condition or a control condition. In the experimental condition, the participants were asked to perform a counter-attitudinal advocacy task that required them to write essays about the costs associated with pursuing the thin-ideal and engage in role-play exercises where they attempted to discourage others from pursuing the thin-ideal. In the control condition, the participants were, instead, asked to write a general essay about an emotionally important topic (e.g., relationships or goals). The participants in the experimental condition reported significantly less positive attitudes towards the thin-ideal and greater reductions in eating disorder behaviours compared with the participants in the control condition. Additionally, it was found that the attitude-change mediated the relationship between condition (experimental versus control) and eating disorder behaviours, consistent with the idea that attitude-change generated the change in subsequent behaviour.

In summary, research has shown that induced compliance interventions have been successful at changing attitudes, so long as the motivation to complete the counter-attitudinal advocacy task cannot be attributed to receiving an incentive or having no choice, so long as any feelings of discomfort during or after performing the counter-attitudinal advocacy task are attributed internally rather than externally, and so long as counter-attitudinal behaviour is performed publicly, rather than privately. Research has also shown that induced compliance interventions have been successful at changing behavioural intentions and subsequent behaviour. Also, research has shown that the changes in attitudes that are engendered by an induced compliance intervention generate the changes in subsequent behaviour.

3.5 Hypocrisy induction paradigm

Although there is promising evidence that induced compliance interventions can change attitudes, and therefore might be appropriate for reducing speeding behaviour through attitude-change, such interventions are not appropriate for drivers who speed in spite of their negative attitudes towards this behaviour. These drivers need an attitude-conversion intervention. The hypocrisy induction paradigm (Aronson, Fried, & Stone, 1991) provides an intervention technique that can be used to potentially help convert attitudes that are, in general, against the act of speeding, into reduced speeding behaviour.

The hypocrisy induction paradigm (Aronson et al., 1991) is a technique designed to make individuals aware of their desirable attitudes through an attitude-saliency sub-task (e.g., drivers who currently speed and who hold negative [i.e., safe] attitudes towards speeding [e.g., “speeding is harmful”] could be asked to state their desirable attitudes or perform a behaviour that makes their desirable attitude salient [e.g., support a local road safety campaign]). At the same time, hypocrisy induction also involves making such individuals aware of their previous behavioural transgressions, through a mindfulness sub-task (e.g., the aforementioned drivers could be asked to recall past instances when they have exceeded the speed limit and therefore have not behaved in line with their attitudes). Making people aware of the discrepancies between their attitudes (e.g., “speeding is harmful”) and their behaviour (e.g., exceeding the speed limit) is theorised to result in cognitive dissonance, which individuals are motivated to reduce. To reduce cognitive dissonance, individuals can either change their subsequent behaviour (e.g., reduce speeding) so that it is in line with their existing attitudes or they can change their attitudes so that they are in line with their past behavioural transgressions. However, behaviour-change is argued to be the primary strategy to reduce cognitive dissonance. This is because changing socially desirable attitudes that are based upon well-accepted normative standards (e.g., societal norms that are against speeding) poses a threat to self-integrity (i.e., viewing oneself as a good, moral person, who acts in line with accepted social norms) whereas changing behaviour does not (Stone, Wiegand, Cooper, & Aronson, 1997). The hypocrisy induction paradigm, therefore, provides a technique that can potentially be used to help drivers convert negative attitudes towards speeding into reductions in subsequent speeding behaviour.

Previous studies have shown that hypocrisy induction interventions can be effective at changing behaviour or proxies for behaviour (e.g., behavioural intentions). In a study by Dickerson, Thibodeau, Aronson, and Miller (1992), the participants (*n*=80 female students who used the university swimming pool) were randomised to an experimental (hypocrisy induction) condition or one of three control conditions. In the experimental condition, participants were given an attitude-saliency sub-task requiring them to make a commitment to conserve water by signing a flyer that urged others to take shorter showers. They were also given a mindfulness sub-task that required them to recall their past behavioural transgressions, which involved recalling times when they had wasted water while showering. In the control conditions, the participants were either given the attitude-saliency sub-task only (control condition 1), the mindfulness sub-task only (control condition 2), or neither of these sub-tasks (control condition 3). The participants in the experimental condition took significantly shorter showers compared to the participants in all control conditions. In addition, the participants in all three control conditions did not differ from one another in terms of how long they spent taking showers. The results, therefore, demonstrated that a hypocrisy induction task, involving both the attitude-saliency *and* mindfulness sub-tasks, can generate behaviour-change (i.e., the juxtaposition of the attitude-saliency and mindfulness sub-tasks are needed to make participants aware of the times when they have not behaved in line with their attitudes, which induces the motivation to change behaviour). On the other hand, attitude-saliency and mindfulness tasks on their own do not generate behaviour-change.

Several studies have supported Dickerson et al. (1992)'s findings (Bator & Bryan, 2007; Stone et al., 1997). However, there are several factors that have been found to dictate whether asking participants to perform a hypocrisy induction task generates behaviour-change. More specifically, previous research shows that hypocrisy induction interventions can be successful at changing behaviour to the extent that the attitude-saliency sub-task is performed publicly, rather than privately, to the extent that the mindfulness sub-task is performed privately, rather than publicly, and to the extent that any feelings of discomfort due to performing the hypocrisy induction task are attributed internally (i.e., to cognitive dissonance) rather than externally.

Public versus private performance of the attitude-saliency sub-task is required because it is harder for participants to dismiss their existing attitudes when those attitudes have been declared to others, than when they have been declared in private. In a study by Stone, Aronson, Crain, Winslow, and Fried (1994), the participants (*n*=72 sexually active young adults) were randomised to one of two experimental conditions, or to one of two control conditions. The participants in the first experimental condition were asked to complete a public attitude-saliency sub-task that required them to compose a short speech advocating safer sex and to deliver it in front of a television camera. The participants in the second experimental condition were asked to complete a private attitude-saliency sub-task that required them to compose a short speech advocating safer sex but not deliver it in front of a television camera. The participants in both experimental conditions were also asked to complete a mindfulness sub-task that required them to describe the situations in the past when they had failed to use condoms (i.e., to make them mindful of times when they had transgressed their desirable attitudes). The participants in the first control condition were asked to complete the public attitude-saliency sub-task only. The participants in the second control condition were asked to complete the private attitude-saliency sub-task only. A significantly greater proportion of the participants in the ‘public’ attitude-saliency and mindfulness condition (experimental condition 1) subsequently purchased condoms than did the participants in the public attitude-saliency only control condition (control condition 1). On the other hand, there was no difference between the ‘private’ attitude-saliency and mindfulness condition (experimental condition 2) and the private attitude-saliency only control condition (control condition 2). These findings are in line with the proposition that a hypocrisy induction task produces behaviour-change to the extent that the attitude-saliency sub-task is performed publicly rather than privately. In addition, the participants in the public attitude-saliency and mindfulness condition subsequently purchased, on average, a greater number of condoms than did the participants in the public attitude-saliency only condition whereas there was no difference between the private attitude-saliency and mindfulness condition and the private attitude-saliency only condition (for further empirical evidence from studies of public versus private preaching of the desirable attitude see Aronson et al., 1991; Stone et al., 1997: study 1).

Private versus public performance of the mindfulness task is important because it avoids public humiliation. Asking individuals to recall past behavioural transgressions of their desirable attitudes typically causes a threat to self-integrity (e.g., Stone et al., 1997). If this threat to self-integrity takes place publicly, it tends to lead to feelings of humiliation, which cannot be reduced through behaviour-change (i.e., because transgressions have already been made public). Instead, attitude-change is more likely in order to ‘save face’ (e.g., Rosenberg, 1970; Stone & Focella, 2011). Generally, when threats to self-integrity from past behavioural transgressions occur privately, humiliation does not tend to follow (Rosenberg, 1970; Stone & Focella, 2011), meaning that behaviour-change is more likely in order to avoid the threat to self-integrity in the future. In a study by (Fried, 1998: study 1), the participants (*n*=60 students) were randomised to one of two experimental conditions or a control condition. The participants in the first experimental condition completed a 'public' attitude-saliency sub-task in which they were asked to advocate the importance of recycling and be videotaped doing so. They also completed a 'private' mindfulness sub-task in which they were asked to anonymously identify their past behavioural transgressions by listing times when they had failed to recycle. These participants were told their list of past behavioural transgressions would be used to identify the best locations for recycle bins. The participants in the second experimental condition completed the same tasks as in the first experimental condition, except that the mindfulness sub-task was made 'public' by asking them to put their name, signature and telephone number at the top of their list of behavioural transgressions. The participants in the control condition were not asked to complete either the attitude-saliency or mindfulness tasks. In line with the proposition that a hypocrisy induction task produces behaviour-change to the extent that the recalling past behaviour transgressions is performed privately, rather than publicly, the participants in the private mindfulness condition (experimental condition 1) volunteered to make a greater number of telephone calls, providing other students on campus with information about the importance of recycling, how to recycle and where to do so than did the participants in the public mindfulness condition (experimental condition 2) or the control condition. Additionally, there was no difference between the public mindfulness condition and the control condition in their subsequent behaviour (for further empirical evidence from studies of private versus public preaching of the past behavioural transgression also see Fried, 1998: study 2; Stone & Fernandez, 2008; Stone & Focella, 2011).

With regards to ‘arousal misattribution’, any feelings of discomfort after performing a hypocrisy induction task need to be attributed internally rather than externally, as is the case for induced compliance tasks (see section 3.4). In a study by Fried and Aronson (1995), the participants (*n*=76 university students) were given an attitude-saliency sub-task in which they were asked to make public speeches about the importance of recycling, as well as a mindfulness sub-task in which they were asked to indicate instances when they had failed to recycle in the past. The participants were randomised to either an ‘misattribution’ condition, or a ‘no misattribution’ condition. In the misattribution condition, the participants were told that the noise, lighting and temperature levels in the laboratory could have ‘powerful effects’ on people and were asked to rate how they felt about these levels (i.e., they were given a possible external cause that could be used to explain any feelings of discomfort that might be experienced during the hypocrisy induction task). In the no misattribution condition, the participants were asked to complete the attitude-saliency and mindfulness sub-tasks only. In line with the idea that a hypocrisy induction task produces behaviour-change to the extent that participants cannot attribute any feelings of discomfort to an external factor, the participants in the no misattribution condition volunteered to make a greater number of telephone calls, providing other students on campus with information about the importance of recycling, how to recycle and where to do so than did the participants in the misattribution condition (for further empirical evidence from studies of arousal misattribution see Fointiat, Somat, & Grosbras, 2011).

In summary, research has shown that hypocrisy induction interventions, which involve both an attitude-saliency sub-task (to make people aware of their desirable attitudes) *and* a mindfulness sub-task (to make people aware of their past behavioural transgressions) have been successful at changing behaviour so long as the attitude-saliency sub-task is performed publicly, rather than privately, the mindfulness sub-task is performed privately, rather than publicly, and any feelings of discomfort during or after the tasks cannot be attributed externally.

3.6 Cognitive dissonance inducing interventions and speeding behaviour

Although cognitive dissonance inducing interventions have been successful at changing behaviour, through attitude-change (induced compliance) and through helping people convert their desirable attitudes into behaviour (hypocrisy induction), very few studies in the literature have tested whether these interventions can change speeding behaviour. To date, no studies have tested whether induced compliance interventions can generate attitude- or behaviour-change for any risky driving behaviour, and only one study has tested whether hypocrisy induction interventions can generate changes in driver behaviour.

Fointiat (2004) randomised participants (n=136 housewives) to one of three experimental (hypocrisy induction) conditions or a control condition. In the first experimental condition, the participants were given an attitude-saliency sub-task that required them to sign a flyer advocating compliance with speed limits and a mindfulness sub-task that required them to state their past behavioural transgressions (times when they had exceeded speed limits). On the basis that hypocrisy induction generates greater cognitive dissonance when discrepancies between socially desirable attitudes and behavioural transgressions of those attitudes pose a threat to self-integrity (Stone et al., 1997), the participants in the second and third experimental conditions received both the attitude-saliency and mindfulness sub-tasks but, prior to completing them, the experimenter either suggested that they must have driven faster than the speed limit in the past in order to threaten self-integrity (experimental condition 2) or that they had not driven faster than the speed limit in the past in order to strengthen self-integrity (experimental condition 3). In the control condition, the participants were given only the attitude-saliency sub-task. All participants were subsequently asked if they would be willing to have a recording tachometer installed in their car in order to measure their driving speed. Fointiat (2004) found that the participants in the three experimental conditions, overall, reported that they would be more willing to have the tachometer installed in their car than did the participants in the control condition (38% compared with 11%, respectively). Also, in line with the idea that hypocrisy induction generates greater cognitive dissonance when self-integrity is threatened, the participants in the condition in which self-integrity was threatened reported that they would be more willing to have the tachometer installed in their car than did the participants in the condition in which self-integrity was strengthened (52% compared with 26%, respectively).

Despite (Fointiat, 2004)'s encouraging results for the effectiveness of hypocrisy induction as an intervention for changing driver behaviour, a major limitation of this study was that the primary outcome measure was participants' willingness to have a recording tachometer installed in their cars. However, behavioural willingness is not a perfect predictor of behaviour. For example, previous research shows that behavioural willingness accounts for 49% of the variance in speeding behaviour (Elliott et al., 2017). Although this is regarded as a 'large' proportion of variance in the social sciences (Cohen, 1992), it represents an imperfect relationship meaning that many drivers who are willing to speed do not go on to do so or vice versa. In addition, the measure of behavioural willingness in Fointiat (2004) was operationalised with respect to having a recording tachometer installed in the participants' cars, not speeding behaviour, which means that, to date, there have been no direct tests of whether hypocrisy induction interventions can generate reductions in speeding behaviour.

In spite of the lack of studies testing induced compliance and hypocrisy induction interventions in the context of driving, both interventions are capable of addressing the problems discussed in chapter 2 for why previous interventions have generally been found to be ineffective at changing attitudes and behaviour. First, it was discussed in chapter 2 (see section 2.4.2.1) that an intervention is more likely to be successful at changing attitudes and reducing speeding behaviour if it is based on theoretically established processes of attitude- and behaviour-change, rather than intuition. Both induced compliance and hypocrisy induction interventions are rooted in an established psychological-theory (i.e., cognitive dissonance theory), which has been supported by research on other social behaviours (see above).

Second, it was discussed in chapter 2 (see section 2.4.2.2) that interventions that tap into direct, first-hand experiences are likely to be successful at generating attitude- and subsequent behaviour-change because they are likely to lead to the formation of strong attitudes. Of the two interventions discussed in this chapter, the induced compliance paradigm is the one that is designed to change attitudes. The induced compliance paradigm involves asking participants to complete a counter-attitudinal advocacy task which taps into experiential learning processes, rather than passive learning processes, as is the case with traditional educational interventions (see chapter 2). Although drivers who complete an induced compliance intervention do not directly experience the negative outcomes of speeding, they are theorised to directly experience a negative outcome of this counter-attitudinal behaviour (i.e., feelings of cognitive dissonance).

Third, it was discussed in chapter 2 (see section 2.4.2.3) that previous work on bi-dimensional attitudes (Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018) suggests that attitude-change interventions should aim to target both the positive dimension of attitudes (i.e., reduce the extent to which drivers evaluate the positive attributes of speeding as being positive) and the negative dimension of attitudes (i.e., increase the extent to which drivers evaluate the negative attributes of speeding as being negative). That research also implied that interventions should focus to a greater extent on the positive attitude dimension rather than the negative attitude dimension. Regardless, induced compliance interventions to change drivers' attitudes can be designed to do both. Specifically, participants can be asked to complete a counter-attitudinal advocacy task that involves making arguments for why speeding is not a positive, or beneficial, behaviour (i.e., targeting the positive attitude dimension) and for why speeding is a negative, or harmful, behaviour (i.e., targeting the negative attitude dimension).

Fourth, it was discussed in chapter 2 (see section 2.4.2.4) that interventions should aim to target explicit attitudes (attitudes of which an individual is consciously aware) on the basis that explicit attitudes have been shown to be independent predictors of speeding behaviour. Additionally, while no research has tested the effects of implicit attitudes (attitudes of which an individual is not consciously aware) on speeding behaviour, research has shown that implicit attitudes are, on their own, correlated with speeding behaviour and research on other social behaviours has shown that they are independent predictors. Therefore, although it was discussed in chapter 2 that further research is needed to establish the independent effects of implicit and explicit attitudes in the context of speeding specifically, it is possible that attitude-change interventions need to target implicit attitudes in addition to explicit attitudes (see chapter 2). Induced compliance interventions can also be designed to achieve this aim. Specifically, a counter-attitudinal advocacy task requires participants to consciously engage in a deliberative argument that contradicts their attitudes, meaning that the task is likely to target explicit attitudes. In addition, a counter-attitudinal advocacy task can also target the participants' implicit attitudes. As discussed in chapter 2, intervention techniques that tap subconscious processes, such as evaluative conditioning can be used to target implicit attitudes. This means that when a behaviour is paired with an evaluation (e.g., speeding is not positive or is negative) repeatedly, the association between the behaviour and the evaluation (i.e., the attitude) becomes implicitly encoded in memory to a greater extent (e.g., Olson & Fazio, 2006). This is likely to happen in an induced compliance intervention if a participant is asked to make multiple arguments for why speeding is not positive or is negative.

Fifth, it was discussed in chapter 2 (see section 2.4.2.5) that different kinds of interventions are needed to reduce speeding for different kinds of drivers, with attitude-change interventions being needed for drivers with undesirable attitudes that are positively oriented towards the act of speeding and attitude-conversion interventions being needed for drivers with desirable attitudes that are negatively oriented towards this behaviour. As discussed in this chapter, the induced compliance paradigm provides an intervention technique for changing undesirable attitudes and the hypocrisy induction paradigm provides a technique for converting desirable attitudes into behaviour.

In the research reported in this thesis, both an induced compliance and hypocrisy induction intervention were developed to address the above-mentioned issues and they were tested using randomised controlled experiments. In addition, the research was designed to address key limitations of previous studies. First, many of the studies discussed in this chapter did not measure cognitive dissonance (Di Bello et al., 2018; Dickerson et al., 1992; Festinger & Carlsmith, 1959; Fointiat, 2004; Fried, 1998: study 1; Fried & Aronson, 1995; Harmon-Jones et al., 2008; Joule & Martinie, 2008; Leippe & Eisenstadt, 1994; Stice et al., 2007; Stone et al., 1994). Rather, attitude-change (in studies of induced compliance) or behaviour-change (in studies of induced compliance and hypocrisy induction) was tested and cognitive dissonance was assumed to be the cause of any observed changes, in line with cognitive dissonance theory. Therefore, cognitive dissonance was measured in the studies presented in this thesis in order to provide an explicit test of whether it accounts for any attitude- or behaviour-change that is generated following an induced compliance or hypocrisy induction intervention.

Second, induced compliance interventions, which are designed to change deviant behaviour by changing undesirable attitudes, have typically been tested using samples that have not been screened to ensure that the participants all hold undesirable attitudes and engage in the problem behaviour in the first place. This means that the effectiveness of the interventions tested in previous studies might have been underestimated because there was little scope to change potentially many participants' attitudes and behaviour for the better. Similarly, hypocrisy induction interventions, which are designed to change deviant behaviour by helping people act on their desirable attitudes, have typically been tested using samples that have not been screened to ensure that the participants all hold desirable attitudes and currently engage in the problem behaviour. This includes Fointiat (2004)'s study focusing on speeding and means that intervention effectiveness in previous studies might have been underestimated because there was potentially little scope to convert desirable attitudes into behaviour-change. Therefore, in the studies presented in this thesis, the participants were screened in order to ensure that the induced compliance intervention was tested using a sample of drivers who, prior to the intervention, reported that they exceeded the speed limit regularly (i.e., behaviour-change required) and that they had undesirable attitudes (i.e., attitude-change required). Similarly, the participants were screened in order to ensure that the hypocrisy induction intervention was tested using a sample of drivers who, prior to the intervention, reported that they exceeded the speed limit regularly (i.e., behaviour-change required) and that they had desirable attitudes (i.e., attitude-conversion required).

Third, the outcome measures used to test the effectiveness of the induced compliance or hypocrisy induction interventions in the above cited studies were typically problematic. For example, as discussed above, Fointiat (2004) used a measure of participants' willingness to install a tachometer in their cars rather than a measure of speeding behaviour when testing a hypocrisy induction intervention (for studies of non-driving behaviour that suffer similar limitations see Fried, 1998; Fried & Aronson, 1995; Simmons & Brandon, 2007) In addition, behaviour is typically measured using self-reports in previous studies of both induced compliance (e.g., Di Bello et al., 2018; Stice et al., 2007) and hypocrisy induction (e.g., Stone et al., 1994) interventions. As discussed in chapter 2, self-reported measures of behaviour can be susceptible to various cognitive biases, such as primacy and recency effects (Murdock, 1962), affective biases such as mood congruent memory effects (Mayer et al., 1995) and self-presentation biases such as self-deception (Gur & Sackeim, 1979) and impression management (Paulhus & Reid, 1991). Objective measures of behaviour were therefore employed in the research reported in the subsequent chapters to better test the effectiveness of both induced compliance and hypocrisy induction interventions.

3.7 Conclusions

In conclusion, cognitive dissonance (Festinger, 1957) is an unpleasant state of arousal (e.g., feeling discomfort) that is experienced when people hold conflicting attitudes, or when they realise they have behaved in a manner that is inconsistent with their attitudes. To reduce cognitive dissonance, people must change either their attitudes or behaviour, thereby achieving a consistency between cognitions and actions. Cognitive dissonance theory, therefore, is well equipped to provide a basis for the development of behaviour-change interventions through the process of attitude-change or attitude-conversion. Specifically, induced compliance interventions can be used to change behaviour through attitude-change and hypocrisy induction interventions can be used to change behaviour through attitude-conversion. The evidence for induced compliance and hypocrisy induction interventions reviewed in this chapter is encouraging but virtually no studies have focused on driving. Despite this, induced compliance and hypocrisy induction interventions can help address the issues in chapter 2 for why previous interventions might not have been effective at reducing speeding. In addition, previous research testing induced compliance and hypocrisy induction interventions suffers several potential limitations. The research reported in this thesis, therefore, aims to develop induced compliance and hypocrisy induction interventions designed to reduce speeding and address the key limitations of previous research more generally.

Chapter 4: Study 1: Predicting speeding behaviour and development of outcome measures[1]

4.1 Abstract

The aim of this study was to determine the constructs that need to be targeted in attitude-change (e.g., induced compliance) interventions. Specifically, the aim of this study was to test whether implicit bi-dimensional attitudes can account for variance in speeding behaviour over and above explicit bi-dimensional attitudes and whether the positivity bias that is typically found with explicit attitudes generalises to implicit attitude. The study was also conducted to develop the key measures of attitudes and behaviour that could be used in the subsequently reported studies testing both induced compliance and hypocrisy induction interventions. 131 drivers completed a questionnaire measuring their explicit bi-dimensional attitudes towards speeding. They also completed Implicit Association Tests measuring their implicit bi-dimensional attitudes. Two weeks later, speeding behaviour was measured using a driving simulator. Explicit attitudes accounted for a significant proportion of the variance in subsequent speeding behaviour. Implicit attitudes accounted for a

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[1] The research reported in this chapter has been published in:

- McCartan, R., Elliott, M. A., Pagani, S. Finnegan, E., Kelly, S. W. (2018). Testing the effects of implicit and explicit bi-dimensional attitudes on behaviour. *British Journal of Social Psychology, 57,* 630-651.
- Elliott, M. A., McCartan, R., Pagani, S., Finnegan, E., & Kelly, S. W. (2016). Measuring implicit bi-dimensional attitudes and predicting speeding behaviour. *International Journal of Psychology,* ***51*** *(S1)*, p1150.

statistically significant increment to explained variance. The positive dimension of both explicit and implicit attitudes predicted speeding behaviour but the negative dimensions did not. As a result, the induced compliance (attitude-change) intervention developed in this thesis was designed to primarily target the positive dimensions of explicit and implicit attitudes and its effectiveness was primarily judged by the extent to which it changed the positive attitude dimension. In addition, the key measures of attitudes and behaviour that could be used in the subsequently reported studies to test the effectiveness of the cognitive dissonance based interventions.

4.2 Introduction

As discussed in chapter 3, cognitive dissonance interventions based on the induced compliance and hypocrisy induction paradigms are likely to be effective at reducing speeding behaviour because they overcome the potential limitations with previous road safety interventions. As discussed in chapter 2, potential reasons for why previous road safety interventions have, in general, been found to be ineffective at changing drivers' attitudes and behaviour are that: they have been based on intuition rather than theoretical principles of behaviour-change; they have attempted to change attitudes through the provision of indirect rather direct experience; they have tended to focus primarily on changing the negative rather than the positive attitude dimension; they have focused only on changing explicit rather than implicit attitudes; and they have not taken into account the importance of attitude-conversion in addition to attitude-change. Cognitive dissonance-based interventions on the other hand, are grounded in theoretical processes of attitude- and behaviour-change and they are held to change attitudes and behaviour through direct experience (i.e., unpleasant feelings of cognitive dissonance). In addition, as discussed in chapter 3, they can be designed to target the positive attitude dimension in addition to the negative attitude dimension, they can be designed to target implicit attitudes in addition to explicit attitudes, and they can be used to change behaviour through the process of attitude-conversion (i.e., hypocrisy induction interventions) in addition to attitude-change (i.e., induced compliance interventions).

The research reported in this thesis was therefore designed to develop and test cognitive dissonance-based interventions to reduce drivers' speeding behaviour through induced compliance (chapter 5) and hypocrisy induction (chapter 6). However, before that research was conducted, an initial empirical investigation, reported in this chapter, was carried out to test the relationships between bi-dimensional attitudes, explicit and implicit attitudes and speeding behaviour, and to develop outcome measures (measures of attitudes and behaviour) that could be used in the subsequent studies to test the effectiveness of the cognitive dissonance-based interventions.

Research on bi-dimensional attitudes and its implications for interventions was discussed in chapter 2. It was mentioned that attitudes are typically treated as unidimensional predictors of behavioural intentions and subsequent behaviour (e.g., Armitage & Conner, 2001; Eagly & Chaiken, 1993). In line with traditional conceptualisations of the attitude construct (e.g., Osgood et al., 1957; Thurstone, 1928), this means that individuals are held to evaluate behaviours along a single bi-polar, positive-negative dimension (e.g., "For me, speeding is negative or positive") and the likelihood of a behaviour being performed is held to increase with the extent to which it is evaluated positively rather than negatively (e.g., Fishbein, 1963).

However, it was also mentioned in chapter 2 that, following research on attitude ambivalence (e.g., Conner & Sparks, 2002), attitudes have been conceptualised as bi-dimensional predictors of behaviour in recent studies (Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018). This means that attitudes comprise separate unipolar, positive and negative dimensions (e.g., “For me, speeding is not at all positive to extremely positive” and “For me, speeding is not at all negative to extremely negative”) and the likelihood of a behaviour being performed is held to increase with the extent to which it is evaluated positively and, at the same time, the extent to which it is not evaluated negatively.

Support for the bi-dimensional conceptualization of attitudes was also reviewed in chapter 2. It was mentioned that factor analytic studies have demonstrated that positive and negative behavioural evaluations load separately onto two independent dimensions (e.g., Conner et al., 2002; Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018) and research focusing on the prediction of behaviour has shown that both the positive and negative attitude dimensions independently predict speeding, with the positive dimension of attitude being a significantly stronger predictor of both behavioural intentions and subsequent behaviour (Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018: study 3). Chapter 2 also discussed that this finding was in line with the majority of previous studies on expectancy beliefs (precursors to attitudes) and health-risk behaviour, in which beliefs about the likelihood of positive behavioural outcomes have been found to predict behaviour to a greater extent than beliefs about the likelihood of negative behavioural outcomes, suggesting a ‘positivity bias’ in behavioural decision-making (e.g., Anderson et al., 2002; Boucher & Osgood, 1969; Fromme et al., 1997; Lawton et al., 2007: study 2;

Lee et al., 1999; Rhodes & Conner, 2010). As a result of the reviewed research evidence, it was concluded that interventions need to target both the positive attitude dimension (e.g., reduce the extent to which drivers evaluate the positive attributes of speeding as being positive) and the negative attitude dimension (e.g., increase the extent to which drivers evaluate the negative attributes of speeding as being negative), although there is likely to be more scope to decrease speeding by focusing on the positive dimension. In the first study of this thesis, the relationships between bi-dimensional attitudes (i.e., the separate positive and negative attitude dimensions) and speeding behaviour were tested in order to provide additional assurance, over and above that provided by previous research (e.g., Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018), that they are reliable predictors of speeding and therefore represent suitable targets for attitude-change (e.g., induced compliance) interventions.

Perhaps more importantly, it was discussed in chapter 2 that researchers have focused almost exclusively on explicit attitudes (attitudes of which an individual is consciously aware) when testing the extent to which attitudes predict behaviour. This means that attitudes have typically been held to influence behaviour through a deliberative process, with individuals consciously considering the positive and negative outcomes of a behaviour before engaging in it (e.g., Elliott, Brewster, et al., 2015; Fazio, 1990a; Fazio & Olson, 2003; Spalding & Hardin, 1999). This raised two potential concerns. First, many real-world behaviours (e.g., speeding), are readily repeatable and are therefore afforded the opportunity to become automatic. This means that spontaneous processes are likely to be involved in the execution of behaviour in addition to more deliberative processes (e.g., Verplanken & Orbell, 2003). Second, explicit attitudes are typically measured using self-report questionnaires, which can be susceptible to various cognitive biases, such as primary and recency effects (Murdock, 1962), affective biases such as mood congruent memory effects (Mayer et al., 1995) and self-presentation biases such as self-deception (Gur & Sackeim, 1979) and impression management (Paulhus & Reid, 1991). As also mentioned in chapter 2, implicitly measured attitudes help to overcome these potential problems because implicit attitudes are attitudes of which individuals are *not* consciously aware and they are held to influence behaviour through a spontaneous, rather than a deliberative, process. More specifically, they are held to be activated spontaneously when individuals encounter salient cues that are associated with a behaviour. These automatically activated attitudes are then held to exert a biasing effect on an individual, effectively priming (initiating rapidly and without conscious awareness) attitude-congruent behaviour (e.g., Fazio, 1990a; Fazio & Olson, 2003). In addition, implicit attitudes are not vulnerable to self-reporting biases because they are measured by performance on cognitive tests, rather than self-report questionnaires (e.g., Banse et al., 2001).

However, as mentioned in chapter 2, no studies have tested whether implicit attitudes can predict speeding behaviour independently of explicit attitudes. While studies on other social behaviours have addressed this issue (Gawronski, Galdi, & Arcuri, 2015; Greenwald et al., 2009; Spence & Townsend, 2007) and studies of speeding have shown that implicit attitudes are, on their own, correlated with speeding (Hatfield et al., 2008), it is important to determine whether both explicit and implicit attitudes independently predict speeding to draw firmer conclusions about whether both types of attitudes are likely to need targeting in attitude-change (e.g., induced compliance) interventions.

In addition, given the findings from studies of explicit bi-dimensional attitudes, it was argued in chapter 2 that implicit attitudes may also have separate positive and negative dimensions that independently predict behaviour. Although several (non-driving) studies have examined the effects of both implicit and explicit attitudes on behaviour (e.g., Gawronski et al., 2015; Greenwald et al., 2009; Spence & Townsend, 2007), no previous studies have tested the independent effects of both implicit and explicit *bi-dimensional* attitudes on any behaviour. The study reported in this chapter was therefore carried out to address this gap in the literature and help determine which types (explicit or implicit) and dimensions (positive or negative) of attitudes needed targeting by the attitude-change (induced compliance) intervention that was developed subsequently. It was expected that implicit bi-dimensional attitudes would predict speeding behaviour over and above explicit bi-dimensional attitudes, in line with research on unidimensional attitudes for other social behaviours (Gawronski et al., 2015; Greenwald et al., 2009; Spence & Townsend, 2007). In line with previous research on explicit bi-dimensional attitudes (Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018), it was expected that both the positive and negative dimensions of (explicit and implicit) attitudes would predict speeding. In line with the positivity bias that has been found in previous research on risky social behaviours (e.g., Anderson et al., 2002; Boucher & Osgood, 1969; Fromme et al., 1997; Lawton et al., 2007: study 2; Lee et al., 1999; Rhodes & Conner, 2010), it was expected that the positive dimensions of both explicit and implicit attitudes would be stronger predictors than the negative dimensions.

As noted above, the first empirical study in this thesis was also conducted to develop and test the measures of attitudes and behaviour to be used in the subsequent studies in which induced compliance and hypocrisy induction interventions were tested. Specifically, measures of explicit bi-dimensional attitudes, implicit bi-dimensional attitudes and speeding behaviour were needed. A measure of explicit bi-dimensional attitudes has already been established in the literature. Specifically, the split semantic differential technique has been used in previous studies testing the bi-dimensional attitude-behaviour relationship (Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018). This study also used the split semantic differential technique to measure explicit bi-dimensional attitudes. In addition to testing the predictive validity of the measures (i.e., the extent to which they predicted speeding), the measures were tested for internal reliability following standard practice (e.g.,Cronbach, 1951; Nunnally, 1978). Tests of independence (i.e., discriminant validity) were also carried out to ensure that the measures of the positive and negative attitude dimensions were independent, in line with theory (e.g., Conner & Sparks, 2002; Kaplan, 1972).

While explicit bi-dimensional attitude measures are established, there is currently no method for measuring implicit bi-dimensional attitudes. As mentioned in chapter 2, the most commonly employed method for measuring implicit attitudes is the Implicit Association Test (IAT; Greenwald et al., 1998; Greenwald et al., 2003; but see Fazio, 2001 for an alternative method). Recall that the IAT is a computer-based reaction time task that assesses the strength of associations between “target concepts” (e.g., behaviours) and “attributes” (e.g., evaluations). In a standard, traditional IAT, a target concept (e.g., speeding) is presented on one side of a computer screen and its opposite concept (e.g., complying) is presented on the other side. Each concept is paired with an attribute (e.g., speeding/good; complying/bad). The participants are presented with items in the middle of the screen relating to both the concepts (e.g., illegal or legal) and the attributes (e.g., happy or nasty). The participants' task is to categorise each item into its relevant category as quickly and accurately as possible (e.g., Greenwald et al., 1998). A measure of attitude (e.g., towards speeding) is then derived from the difference in the participants' response latencies (i.e., time taken to categorise items) in 'compatible trials', when the target concept is paired with 'good' and its opposite concept is paired with 'bad', and their response latencies in the 'incompatible trials', when the target concept is paired with 'bad' and its opposite concept is paired with 'good' (Greenwald et al., 1998; Greenwald et al., 2003). The rationale is that faster response latencies in compatible trials relative to incompatible trials indicate a more positive attitude towards the target concept (see section 2.3.2.2). However, this type of IAT measures unidimensional attitudes because it captures positive *or* negative evaluative orientation towards a behaviour. Therefore, this study developed IATs to measure implicit bi-dimensional attitudes, one to measure the positive dimension and one to measure the conceptually separate negative dimension. As was the case with the explicit measures of bi-dimensional attitudes, the psychometric properties of the implicit attitude measures from the IATs (internal reliability, discriminant validity and predictive validity) were tested to determine their suitability.

This study also aimed to develop a driving simulator route to measure participants' speeding behaviour. This was deemed important because, as discussed in chapters 2 and 3, self-reported behaviour measures are normally used to test interventions (e.g., Di Bello et al., 2018; Stice et al., 2007) and they can be susceptible to various cognitive, affective and self-presentational biases (e.g., Gur & Sackeim, 1979; Mayer et al., 1995; Murdock, 1962; Paulhus & Reid, 1991). Objective measures of behaviour, which are less vulnerable to these criticisms, are therefore needed to help overcome the limitations with the majority of previous studies. Objective measures of behaviour obtained from naturalistic settings in the real world (e.g., black box technology to measure driving speeds in everyday driving) are often regarded as gold standard in road safety research (e.g., Carsten, Kircher, & Jamson, 2013). However, they are problematic for testing road safety countermeasures such as induced compliance and hypocrisy induction interventions because the purpose of these interventions is to prevent the occurrence of the problem behaviour (e.g., speeding) when people have the opportunity to perform it and it is not possible to control for opportunity in naturalistic settings in the real world. For example, road, traffic and weather conditions can put undue constraints upon driver behaviour, removing the opportunity to speed in many circumstances (e.g., when driving in congested traffic or poor weather). This will, in turn, make it difficult to detect genuine intervention effects. Furthermore, the constraints upon behaviour from naturalistic, real-world settings are not possible to equalise across participants, meaning that real-world data are extremely noisy, which again undermines a study’s ability to detect intervention effects (e.g., Kaptein, Theeuwes, & Van Der Horst, 1996). For these reasons, a driving simulator was deemed suitable for obtaining objective measures of speeding in this PhD research because it allows objective behaviour measures to be collected under experimentally controlled conditions, where all participants can be exposed to the same stimuli.

In line with the above discussion, the aim of this research was to test the effects of explicit and implicit bi-dimensional attitudes on drivers' speeding behaviour in order to determine the constructs that need to be targeted in attitude-change (e.g., induced compliance) interventions. The study was also conducted to develop the key measures of attitudes and behaviour that could be used in the subsequently reported studies testing both induced compliance and hypocrisy induction interventions. In line with previous research (e.g., Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018), hypothesis 1 was that the positive and negative dimensions of explicit attitudes would account for a significant proportion of the variance in speeding behaviour on the driving simulator, with the positive dimension being the stronger predictor. Hypothesis 2 was that the positive and negative dimensions of implicit attitudes would account for a significant increment to explained variance in behaviour, over and above the explicit measures, with the positive dimension again being the stronger predictor.

4.3 Method

4.3.1 Participants

One hundred and thirty-one active drivers (full UK driving licence holders who drove at least once a week) took part. The participants were recruited using advertisements placed on notice boards around the campus of a large university in the west of Scotland and online posts (e.g., advertisements on social networking sites and the virtual learning environment of the university). The mean age of the sample was 22.66 (*SD*=8.50; range=18-65) and 21.4% was male (*N*=28). The mean weekly mileage was 74.81 (*SD*=75.90; range=1- 400), and the mean number of years that the participants had held a full driving licence for was 4.09 (*SD*=6.84; range=0.16 - 38).

Power analysis indicated that the power provided by the present sample (n=131) to detect a meaningful (small to moderate) sized relationship (*r* = .22 for correlation and f^2 = .10 for regression with four independent variables) was power = 0.82. Given this power estimate was above 0.80 (see Cohen, 1992), it was concluded that the present study was sufficiently powered for testing the hypotheses.

4.3.2 Design and Procedure

Ethical approval for conducting this study was awarded by the University's School of Psychological Sciences and Health ethical committee. Data collection for this study was carried out by myself and a postgraduate student at the University, under my supervision. A prospective design was used. The participants were invited to participate after being informed the study was a general-purpose investigation into driver behaviour and attitudes, meaning that no deception was involved in this study (see appendix A). All of the participants were invited to the Social Cognition Laboratory situated in the School of Psychological Sciences and Health. After providing their consent, the participants completed a questionnaire that contained standard items to measure basic demographic information (e.g., age, gender, weekly mileage, number of years licenced to drive) and explicit attitudes towards exceeding the speed limit (both the positive and negative dimensions, separately). The participants also completed IATs to measure their implicit attitudes towards exceeding the speed limit (again, both the positive and negative dimensions, separately). The questionnaire took approximately 5 minutes to complete and was developed and administered using Qualtrics. The IATs took approximately 15 minutes to complete and were developed and administered using E-Prime. Half of the participants received the questionnaire first and half received the IATs first in order to control for any potential order effects.

Two weeks later, the participants were invited to the Driving Research Laboratory situated in the School of Psychological Sciences and Health where objective measures of speeding were obtained from a 15 minute (approximately) drive on the driving simulator. After completing the simulator drive, the participants were thanked and debriefed, in line with ethical guidelines.

4.3.3 The explicit attitude measures

Explicit attitudes were measured using standard questionnaire items (i.e., commonly employed in the literature and shown to produce reliable measures; Elliott et al, 2015, McCartan & Elliott, 2018). The participants were asked to respond to the items that measured their attitudes towards exceeding the speed limit using 9-point scales. All attitude items were presented in a pseudo- random order, with the response scales reversed for half the items in order to reduce response set bias (e.g., Nederhof, 1985). These measures were presented amongst ‘filler items’ asking the participants about their general driving practices (e.g., how often they drive in urban areas) in order to help prevent consistency biases (e.g., Budd, 1987) from influencing the participants’ responses.

The split semantic differential technique (Kaplan, 1972) was used to measure the separate positive and negative dimensions of attitude. Four items were used to measure the positive dimension. The participants were asked to (1) “Think only about the positive outcomes that you associate with speeding” and to rate “How positive are they?”; (2) “Think only about the rewarding outcomes that you associate with speeding” and to rate “How rewarding are they?”; (3) “Think only about the beneficial outcomes that you associate with speeding" and to rate "How are beneficial are they?"; and (4) "Think only about the pleasant outcomes that you associate with speeding" and to rate "How pleasant are they?". The participants' ratings were provided on scales 9 point-scales. For example, "not at all positive (scored 1) to "extremely positive" (scored 9). The mean of the four items was calculated and used as the final measure of the explicit positive attitude dimension. Higher scores indicated that the positive outcomes of speeding were rated more positively.

Four items were also used to measure the negative dimension of attitude. The participants were asked to (1) "Think only about the negative outcomes that you associate with speeding" and to rate "How negative are they?"; (2) "Think only about the unrewarding outcomes that you associate with speeding" and to rate "How unrewarding are they?"; (3) "Think only about the harmful outcomes that you associate with speeding" and to rate "How are harmful are they?"; and (4) "Think only about the unpleasant outcomes that you associate with speeding" and to rate "How unpleasant are they?". The participants' ratings were provided on scales 9 point-scales. For example, "not at all negative (scored 1) to "extremely negative" (scored 9). The mean of the four items was calculated and used as the final measure of the explicit negative attitude dimension. Higher scores indicated that the negative outcomes of speeding were rated more negatively.

4.3.4 The implicit attitude measures

A standard IAT, as described in the introduction (section 4.2), is appropriate for measuring implicit unidimensional attitudes (i.e., positive or negative associations). However, 'single attribute' IATs (e.g., Penke, Eichstaedt, &

Asendorpf, 2006) are required to measure the separate positive and negative dimensions of implicit bi-dimensional attitudes. Single-attribute IATs are typically used when an attribute has no clear opposite category (e.g., sociosexuality: Penke et al., 2006). However, single attribute IATs have not previously been used to measure bi-dimensional attitudes. Single-attribute IATs were therefore developed to measure implicit bi-dimensional attitudes in this research. This study served as a pilot test of these single-attribute IATs.

Table 4.1. Sequence of trial blocks for single attribute-IAT measuring the positive dimension of attitude.

Block	No. of Trials (i.e., words per block)	Function	Top Left of Screen in Version 1 of the IAT	Top Right of Screen in Version 1 of the IAT
1	20	Practice	Speeding	Complying
2	20	Practice	Speeding + Good	Complying
3	40	Test	Speeding + Good	Complying
4	20	Practice	Speeding	Complying + Good
5	40	Test	Speeding	Complying + Good

The single attribute IAT to measure the positive dimension of attitude comprised 5 blocks of ‘trials’ (see Table 4.1 and Appendix B). In block 1, the participants were shown a computer screen. The target concept-category ‘speeding’ was presented at the top of one side of the screen. The opposite concept-category ‘complying’ was presented at the top of the other side of the screen. The participants were then shown a series of items in the centre of the screen that either belonged to the ‘speeding’ or ‘complying’ concept-categories. The participants were asked to correctly categorise these items as quickly and accurately as possible. The participants were presented with 5 items related to 'speeding' (fast, rush, speeding, illegal and disobey) and 5 items related to 'complying' (slow, cautious, adhere, legal and comply). These items were selected on the basis that they were either a synonym of the target-concepts, or they were semantically related to the concepts. Each item was presented twice, meaning that there were 20 trials in total. The participants were asked to press the 'E' key on the computer keyboard when the item belonged to the concept-category on the left of the screen and to press the 'I' key when the item belonged to the category on the right. The items remained on the screen until a response was given and, if an incorrect response was given (e.g., if a speeding-related item was categorised as 'complying'), an X appeared in the centre of the screen until the correct response was provided.

In block 2, the participants were presented with the same display as in block 1, except that the single-attribute category 'good' was paired with the concept category at the top left of the screen. The participants were then presented with the same series of 'speeding'/ 'complying' items used in block 1. They were also presented with five items related to the attribute category 'good' (happy, fun, wonderful, positive and enjoyable). Each of the items from the concept and attribute categories ('speeding', 'complying' and 'good') was presented at least once. Five of the items were shown twice. Of these items, three items belonged to the concept category on the left side of the screen, one belonged to the concept category on the right and one belonged to the attribute category. This meant that block 2 comprised 20 trials and the number of items that the participants needed to categorise on the left and right sides of the screen was proportional to the number of categories. As in block 1, the participants were asked to press 'E' on the keyboard when the item belonged a category on the left of the screen and 'I' when it belonged to the category on the right.

In block 3, the participants completed the same task as in block 2 except that they needed to classify twice as many items (i.e., there were 40 trials in block 3). In blocks 4 and 5, the participants were given the same tasks as in blocks 2 and 3 except that the attribute category 'good' was paired with the concept category on the right rather than the left of the screen.

There were two different versions of this single target-IAT. In version 1, the target-concept category 'speeding' was presented on the left-hand side of the screen and the opposite-concept category 'complying' was on the right. In version 2, this was reversed. Half of the participants were selected at random to receive version 1 and half were selected at random to receive version 2 in order to counter-balance across the sample. This procedure was used to address the commonly found order effect in IAT research, with performance on the compatible or incompatible trials being faster when it is completed first (i.e., blocks 2 and 3) compared with when it is completed second (i.e., blocks 4 and 5; e.g., Greenwald et al., 2003). In both IATs, the inter-trial interval (milliseconds between each trial) used was 250ms, consistent with standard practice (e.g., Greenwald et al., 2003).

Regardless of which version of the IAT the participants received, the response latencies to the blocks in which the attribute category was paired with the 'speeding' target concept-category (commonly referred to as 'compatible trials') and the blocks in which it was paired with the 'complying' opposite-concept category (commonly referred to as 'incompatible trials') were used to derive a '*D*-score' (see

Greenwald et al, 2003). This *D*-score served as the implicit measure of the positive attitude dimension. Following Greenwald et al. (2003) the mean response latencies (the time in milliseconds it took for participants to correctly classify each item) for the compatible trials was subtracted from the mean response latencies for the incompatible trials. This meant that higher scores equated to faster categorisation of items when ‘good’ was paired with ‘speeding’ rather than ‘complying’ (i.e., higher scores equated to more positive attitudes towards speeding). The difference between the participants’ mean latencies of response in the compatible vs incompatible trials was divided by the standard deviation across the compatible and incompatible trials to produce an overall measure of effect size (i.e., *D*). In line with standard practice (i.e., Greenwald et al., 2003), this procedure was used to calculate a *D*-score for blocks 2 vs 4 and 3 vs 5, separately and the mean of the two scores served as the final measure (*D*) of the positive dimension of the participants’ implicit attitudes towards speeding[2].

[2] Blocks 2 and 4 are referred to as “practice blocks” in the IAT literature and blocks 3 and 5 are referred to as “test blocks”. While some researchers treat blocks 2 and 4 as genuine practice bocks, Greenwald et al. (2003) recommends that they are used to calculate the final IAT measure of attitudes along with blocks 3 and 5 on the basis it leads to larger correlations between implicit and explicit attitude measures than when either the practice or test blocks are used on their own. This accepted procedure was therefore followed. It should be noted, however, that the findings were the same regardless of whether or not the “practice blocks” were used to calculate the implicit attitude measures.

The negative dimension of implicit attitudes was also measured using a single attribute IAT (see Table 4.2).

Table 4.2. Sequence of trial blocks for single attribute-IAT measuring the negative dimension of attitude.

Block	No. of Trials (i.e., words per block)	Function	Top Left of Screen in Version 1 of the IAT	Top Right of Screen in Version 1 of the IAT
1	20	Practice	Complying	Speeding
2	20	Practice	Complying + Bad	Speeding
3	40	Test	Complying + Bad	Speeding
4	20	Practice	Complying	Speeding + Bad
5	40	Test	Complying	Speeding + Bad

This IAT was the same as the one used to measure the positive dimension of implicit attitudes except that the attribute category ‘bad’, rather than ‘good’, was paired with the target-concept ‘speeding’ and the opposite concept ‘complying’ in blocks 2-5. In addition to correctly categorising the items relating to speeding and complying, the participants therefore had to correctly categorise items relating to the attribute category ‘bad’ (evil, disaster, awful, negative and nasty). Once again, there were two different versions of the IAT. In version 1, the target-concept category ‘speeding’ was presented on the left-hand side of the screen and the opposite-concept category ‘complying’ was presented on the right. In version 2, this was reversed. In order to counter-balance across the sample, the participants who received version 1 of the IAT to measure the positive dimension of attitude received version 1 of this IAT. Similarly, the participants who received version 2 of the IAT to measure the positive dimension of attitude received version 2 of this IAT. To control for any potential practice effects, the order in which the participants received their two IAT's varied. The participants either received the positive single-attribute IAT first or the negative single-attribute IAT first.

A final measure of the negative dimension of the participants' implicit attitudes towards speeding was calculated following the same procedure as for the positive dimension of their implicit attitudes. The mean of the response latencies in the incompatible trials ('bad' paired with 'complying') was subtracted from the mean of the response latencies in the compatible trials ('bad' paired with 'speeding'), meaning that higher scores reflected more negative attitudes towards speeding. This difference was then divided by the standard deviation across the compatible and incompatible trials for the 'practice' and 'test' blocks separately and the mean of the resulting *D*s served as the final measure (*D*) of the negative dimension of the participants' implicit attitudes.

It should be noted that the data from all IATs were trimmed following standard procedures (Greenwald et al., 2003). All response latencies that were over 10,000ms were removed in order to ensure that the data were not contaminated by trials that were "abnormally slow". Across all IATs there were just n =5 participants with response latencies over 10,000ms. In each case, the maximum number of abnormally slow trials was just n =2. These participants' final D score were calculated using the remaining latencies. Greenwald et al. (2003) also recommends that participants should be removed from the sample if more than 10% of their response latencies are less than 300ms in order to prevent contamination by "abnormally fast" trials. In this study, there were no participants with more than 10% of their trials less than 300ms.

4.3.5 The speeding behaviour measure

The driving simulator used in this study was a STISIM Drive Model 400W fixed-based driving simulator modelled on the layout of a British car (i.e., right-hand drive; see Appendix C). The simulator had a three screen, high resolution display, which provided a 135 degree forward field-of-view. The simulator operated with an automatic transmission and had auditory and steering wheel feedback. It had controls (e.g., a steering wheel, brake, clutch, accelerator, gear stick, horn, indicators, speedometer, and tachometer) that are situated and operate as in a real-world vehicle. The rear view mirrors were was shown at the top of the centre screen and a speedometer and tachometer were shown at the bottom. The wing mirrors were shown on the side screens.

The participants were initially given a five-minute practice drive to get used to the simulator controls. Following the practice drive, the participants completed the trial route, which comprised a 7.06-mile section of road through an urban environment. An urban environment was chosen because most traffic crashes occur on roads in built-up areas (Department for Transport, 2018e). Prior to driving the trial route, the participants were told to treat the drive as if it were a real drive in the real world. They were told that the speed limit was 30mph and to drive straight ahead (i.e., not to turn at any junctions). The trial route comprised junctions, zebra crossings, and traffic modelled in the oncoming lane in order to increase the fidelity of the drive. No traffic were modelled in the driving lane and no pedestrians were programmed to cross the road at any of the zebra crossings, allowing participants to freely choose their driving speed without constraint. The measure of speeding behaviour used in the data analysis was the percentage of the trial route that the participants spent driving over the 30mph speed limit. This was operationalised as 30.50mph in order to prevent micro-fluctuations in speed around 30mph from unduly influencing the results. The mean speed for each participant was also extracted from the simulator as an additional behaviour measure.

Previous research (McCartan & Elliott, 2018) has shown that measures of speeding behaviour obtained in the present driving simulator correlate well with self-reported measures of speeding in the real world ($r = .65$, $p < .001$). The demographic and socio-cognitive variables that are typically associated with real-world speeding behaviour and traffic-crash rates are also associated with speeding behaviour as measured on this driving simulator. More specifically, accumulated research in road safety has shown that age and driving experience are the key demographic predictors of both real-world speeding and traffic-crash risk, with younger and less experienced drivers being found to speed more often and have higher traffic-crash rates than older and more experienced drivers (e.g., Department for Transport, 2018i; McCartt, Mayhew, Braitman, Ferguson, & Simpson, 2009; Stradling et al., 2003). Re-analyses of data from an independent study by Brewster, Elliott, McCartan, McGregor, and Kelly (2016) showed that both these demographic variables were reliable predictors of both mean speed (for age: $\beta = -.27$, $p < .001$; for driving experience: $\beta = -.25$, $p < .01$) and the proportion of time that participants spend driving over the speed limit (for age: $\beta = -.26$, $p < .01$; for driving experience: $\beta = -.23$, $p < .01$) on this driving simulator. Conner et al. (2007: study 2) showed that the socio-cognitive variables that predict on-road vehicle speeds in the real world were behavioural intention ($\beta =$ -

.35, $p < .01$), perceived behavioural control ($\beta = -.03$, $p < .05$) and moral norm ($\beta = -.21$, $p < .05$). Re-analysis of the data collected by Brewster et al. (2016) showed that behavioural intention ($\beta = -.35$, $p < .01$), perceived behavioural control ($\beta = -.14$, $p < .05$) and moral norm ($\beta = -.16$, $p < .05$) also predicted vehicle speed in this driving simulator.

4.3.6 Statistical analysis

Data analysis was conducted using SPSS statistical analysis software. Tests of internal reliability were conducted using Cronbach's alphas. Correlations were conducted between explicit bi-dimensional attitudes, implicit bi-dimensional attitudes, and behaviour. In addition, a two-step hierarchical multiple linear regression was conducted. The rationale for using this statistical analysis was because it was necessary for the explicit bi-dimensional attitudes to be entered together at step 1 of the regression in order to ascertain the independent effects of both the positive and negative dimensions of explicit attitudes on the one hand, and behaviour, on the other (i.e., to test hypothesis 1). It was also necessary for the implicit bi-dimensional attitudes to be entered together at step 2 of the regression in order to determine if implicit bi-dimensional attitudes had independent effects on behaviour and if they explained any increment in the variance in behaviour (i.e., to test hypothesis 2).

4.4 Results

4.4.1 Scale reliabilities and tests of discriminant validity

The tests of internal reliability for the explicit and implicit bi-dimensional attitude measures and the tests of discriminant validity (correlations amongst the attitude measures) are shown in Table 4.3.

Table 4.3. Descriptive statistics and correlations for all attitude measures and speeding behaviour measures.

Variable	1.	2.	3.	4.	5.	6.	Mean (SD)	Cronbach α
1. Speeding behaviour (% of the simulator drive spent exceeding the speed limit)	-	.88***	.53***	-.30**	.24**	-.07	26.70 (27.10)	N/A
2. Mean speed		-	.42***	-.22*	.26**	-.01	29.00 (3.27)	N/A
3. Explicit Positive			-	-.52***	.05	-.03	3.20 (1.86)	.88
4. Explicit Negative				-	-.13	.02	7.53 (1.42)	.73
5. Implicit Positive					-	.14	-0.16 (0.29)	.69
6. Implicit Negative						-	0.22 (0.28)	.64

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

The Cronbach's alphas for the explicit positive and negative attitude dimensions were $\alpha = 0.88$ and $\alpha = 0.73$, respectively, and, therefore, these measures were judged to possess internal reliability (i.e., $\alpha > 0.70$; Cronbach, 1951; Nunnally, 1978). Recall that there were two versions of both IATs (see section 4.3.4). The Cronbach's alphas for versions 1 and 2 of the implicit positive attitude dimension IAT were $\alpha = 0.72$ and $\alpha = 0.66$, respectively. This meant that the Cronbach's alpha for the overall measure of the positive dimension of implicit attitudes was $\alpha = .69$ (see Table 4.3). The Cronbach's alphas for versions 1 and 2 of the implicit negative attitude dimension IAT were $\alpha = 0.61$ and $\alpha = 0.68$, respectively. This meant that the Cronbach's alpha for the overall measure of the negative dimension of implicit attitudes was $\alpha = .64$ (see Table 4.3).

The discriminant validity of the positive and negative attitude dimensions measures was assessed by inspecting the correlations between them. The correlations in Table 4.3 show that the positive and negative dimensions of explicit attitudes were negatively correlated, meaning that the more the participants evaluated the positive outcomes of exceeding the speed limit as being positive, the less they evaluated the negative outcomes as being negative. However, the correlation was below $r = .70$, which is the conventionally accepted criterion for demonstrating independence and thus discriminant validity (Tabachnick & Fidell, 1996). Similarly, the positive and negative dimensions of implicit attitudes were independent because they were not correlated significantly (see Table 4.3). In addition, neither of the explicit attitude measures correlated with the implicit measures, further supporting the discriminant validity of the measures employed in this study.

4.4.2 Descriptive statistics and correlations between the attitude and behaviour measures

The sample means, standard deviations and correlations for the explicit and implicit attitude measures and the measure of speeding behaviour are also shown in Table 4.3. The sample mean for the explicit positive attitude dimension was below the scale mid-point (i.e., 5), which indicates that the participants did not, on average, explicitly evaluate the positive outcomes of exceeding the speed limit very positively. The sample mean for the explicit negative attitude dimension was towards the top end of the scale, indicating that the participants, on average, explicitly evaluated the negative outcomes of exceeding the speed limit as very negative. The sample mean for the implicit positive attitude dimension was below zero, indicating that the participants, on average, did not have strong positive implicit attitudes towards speeding. The sample mean for the implicit negative attitude dimension, on the other hand, was greater than zero, indicating that the participants, on average, had negative implicit attitudes towards speeding. The mean percentage of drive spent exceeding the speed limit was 26.70%, indicating that the participants, on average, exceeded the speed limit for just over a quarter of the simulator drive. The mean speed was 29.00mph, indicating that the participants, on average, drove just below the speed limit during the simulator driveAs would be expected, the positive dimension of explicit attitudes was positively correlated with behaviour (i.e., the more participants evaluated the positive outcomes of exceeding the speed limit as positive, the more they exceeded the speed limit) whereas the negative dimension of explicit attitude was negatively correlated with behaviour. Similarly, the positive dimension of implicit attitudes was positively correlated with behaviour. However, the negative dimension of implicit attitudes was not.

4.4.3 Predicting behaviour using explicit and implicit measures of bi-dimensional attitudes

A two-step hierarchical multiple linear regression was conducted to test both hypothesis 1 and 2 (see Table 4.4). The dependent variable was the % of the drive spent exceeding the speed limit (note that another regression using mean driving speed on the simulator as the dependent variable produced the same pattern of findings as this regression)[3]. The independent variables at step 1 were the explicit positive and negative dimensions of attitude. The implicit positive and negative dimensions of attitude were added to the regression at step 2.

Table 4.4. Hierarchical multiple linear regression predicting speeding behaviour from the explicit and implicit positive and negative dimensions of attitude.

Step	Predictor	R^2	R^2_{Change}	F_{change}	β at step 1	β at step 2
1.	Explicit attitudes	.28	.28	23.96***		
	Positive dimension				.51***	.51***
	Negative dimension				-.04	-.01
2.	Implicit attitudes	.33	.05	4.628*		
	Positive dimension				-	.22**
	Negative dimension				-	-.09

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

[3] The results of the regression with mean driving speed as the dependent variable are not presented only for sake of brevity.

Table 4.4 shows that 28% of the variance in speeding behaviour was accounted for at step 1 of the regression model. The positive dimension of explicit attitudes was an independent predictor. The negative dimension of explicit attitudes was not. Also, the positive dimension of explicit attitude had a significantly larger standardised regression coefficient than did the negative dimension, t (125) = 5.36, p < .001. Therefore, the null is rejected for hypothesis 1.

Table 4.4 also shows that there was a 5% increase to explained variance in speeding behaviour at step 2 of the regression model[4]. The positive dimension of implicit attitude was an independent predictor. The negative dimension of implicit attitude was not. Also, the positive dimension of implicit attitude had a significantly

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[4] Research on unidimensional attitudes shows that affective attitudes are typically stronger predictors of behaviour than are cognitive (instrumental) attitudes (e.g., Lawton et al., 2009) and that implicitly measured attitudes add little to the prediction of behaviour over and above explicitly measured affective attitudes (e.g., Conner, Prestwich, & Ayres, 2011). This raises the possibility that the additional variance accounted for at step 2 of the regression model was due to the implicit measures containing more affective than cognitive attribute-items (i.e., each IATs required the participants to categorise four emotive attributes [e.g., 'happy', 'fun', 'wonderful' and 'enjoyable'] and just one instrumental attribute [e.g., 'positive']) and the explicit measures containing more cognitive than affective attitude-items (i.e., the questionnaires required the participants to rate three instrumental items [e.g., 'positive', 'rewarding' and 'beneficial'] and just one affective item [e.g., 'pleasant']). To rule out this possible explanation for the results, the regression analysis presented in the main text was re-run with explicit and implicit attitude measures that were computed using just the cognitive attitude items and, again, using just affective attitude items. In both cases, the pattern of results was the same as reported in Table 4.4.

larger standardised regression coefficient than did the negative dimension, $t(123) = 2.71$, $p < .01$. The positive dimension of explicit attitudes remained an independent predictor of behaviour at step 2 and the negative dimension of explicit attitudes still did not predict behaviour. Also, at step 2, the positive dimension of explicit attitude still had a significantly larger standardised regression coefficient than did the negative dimension of explicit attitude, t (123) = 5.13, $p < .001$[5]. Therefore, the data provides evidence to reject the null for hypothesis 2.

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[5] The positive attitude dimensions (both explicit and implicit) had slightly better internal reliabilities and larger standard deviations than did the negative attitude dimensions (see Table 4.3). This raises the possibility that the larger standardised regression coefficients for the positive versus negative attitude dimensions were attributable to differential regression attenuation or differences in measurement variance (e.g., Goodwin & Leech, 2006). To rule out differential regression attenuation, the regression presented in the main text was re-run using the disattenuated correlation matrix (e.g., Muchinsky, 1996). The pattern of findings was the same as presented in Table 4.3. To rule out measurement variance, the variance within each attitude measure was calculated. Two repeated measures Analyses of Variance (ANOVAs) were then conducted testing the difference in variance between the positive and negative implicit attitude dimensions (ANOVA 1) and the positive and negative explicit attitude dimensions (ANOVA 2). ANOVA 1 was not statistically significant, F (1,130) = .172, p = .679. However, ANOVA 2 revealed that the variability in the positive dimension of explicit attitude was greater than was the variability in the negative dimension of explicit attitude, F (1,130) = 15.29, p < .001. Given the procedures for estimating regression coefficients while controlling for measurement variability are problematic (Glass & Hopkins, 1996), the 12 cases that contributed most towards the variability in the explicitly measured positive attitude dimension were removed from the sample. A repeated measures ANOVA showed that the difference in the variability between explicitly measured positive and negative attitude dimensions was no longer statistically significant, F (1, 118) = 3.50, p = .064. Next, the regression presented in the main text was re-run with the aforementioned 12 cases removed and the pattern of findings was the same.

4.5 Discussion

4.5.1 Bi-dimensional effects of explicit and implicit attitudes on behaviour

One aim of this research was to test the effects of explicit and implicit bi-dimensional attitudes on drivers' speeding behaviour in order to determine the constructs that need to be targeted in attitude-change (e.g., induced compliance) interventions, with a view to informing the next study (see chapter 5). Hypothesis 1 was that the positive and negative dimensions of explicit attitudes would account for a significant proportion of the variance in behaviour, with the positive dimension being the stronger predictor. Hypothesis 2 was that the positive and negative dimensions of implicit attitudes would account for a significant increment to explained variance in behaviour, with the positive dimension being the stronger predictor.

The null was rejected for hypothesis 1, as the positive and negative dimensions of explicit attitudes together accounted for a significant proportion of the variance in speeding behaviour. The positive dimension was found to predict speeding behaviour whereas the negative dimension was not. Tests of the difference between the predictive validities of the two attitude dimensions also showed that the positive attitude dimension was also significantly more predictive of behaviour than was the negative dimension. The results from this study, therefore, extend the findings from studies of unidimensional attitudes (e.g., Armitage & Conner, 2001; Eagly & Chaiken, 1993) in which attitudes are conceptualised as either positive or negative evaluations. They also support the positivity bias that is typically found in previous studies of bi-dimensional attitudes with the positive attitude dimension being more predictive of behaviour than the negative dimension (Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018).

It is worth considering, however, that while the findings are consistent with all previous studies of bi-dimensional attitudes (Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018) and virtually all previous studies of expectancy beliefs (Anderson et al., 2002; Fromme et al., 1997; Lawton et al., 2007: study 1; Lee et al., 1999; Rhodes & Conner, 2010), one study by Lawton et al. (2007: study 1) found that expectancy beliefs about the likelihood of negative affective outcomes had larger standardised regression weights in the prediction of speeding behaviour than did beliefs about the likelihood of positive affective outcomes. The reason for the discrepancy is unlikely to be a result of Lawton et al. (2007) focusing on affective beliefs and the present research focusing on attitudes more generally (i.e., overall measures of cognitive plus affective attitudes). This is because supplementary analyses showed that the positive dimension of attitude still predicted behaviour to a greater extent than the negative dimension when cognitive and affective attitudes were separated (see footnote 4). One possible reason for the discrepancy between the findings of this study and Lawton et al. (2007: study 1) is that the mean age of the drivers in this sample was 22.66 years old and in Lawton et al. (2007: study 1) it was 49 years old. It is possible that the older sample used in Lawton et al. (2007: study 1) had accumulated more experience of the negative consequences of speeding, thus reinforcing their beliefs about the negative outcomes of this behaviour, which in turn would be expected to increase the relationship with behaviour (cf Fazio & Zanna, 1981). However, in Elliott, Brewster, et al. (2015: study 3) the mean age of the sample was 56 years old. That study also focused on recent speed limit offenders from the general population, all of whom had received a recent negative outcome for their behaviour (being caught by the police in the last four months). Despite the potential reinforcement of the negative attitude dimension, it was still found that the positive dimension of attitude was more predictive of subsequent speeding, in line with the findings of this study and all other studies of outcome beliefs (e.g., Anderson et al., 2002; Fromme et al., 1997; Lawton et al., 2007: study 2; Lee et al., 1999; Rhodes & Conner, 2010), with the exception of Lawton et al. (2007: study 1). The overall consensus, therefore, is that the positive dimension of attitude is the primary dictator of behaviour, with individuals' evaluations of positive behavioural outcomes outweighing their evaluations of negative behavioural outcomes when deciding to act.

It is also worth noting that the negative dimension of explicit attitude was not a significant predictor of behaviour in this study. While it has been shown to predict behaviour in previous research, along with the positive dimension, the effect size has been small. For example, as stated in chapter 2 (section 2.3.2.1), Elliott, Brewster, et al. (2015: 3 study) showed that the beta-weight for the negative dimension of explicit attitude in the prediction of speeding behaviour on both urban and rural roads was just $\beta = -.11$ (compared with $\beta = .31$ and $\beta = .38$ for the positive attitude dimension on urban and rural roads, respectively). Thus, the evidence, overall, illustrates the utility of the positive attitude dimension in the prediction of behaviour at the expense of the negative attitude dimension.

The null was also rejected for hypothesis 2, as this study demonstrated that the positive and negative dimensions of implicit attitudes together accounted for a significant increment to explained variance in speeding behaviour over and above the variance that was accounted for by the positive and negative dimensions of explicit attitudes. This finding is therefore in line with research on unidimensional attitudes towards non-driving behaviours in which implicit measures of attitudes have been found to add variance to behaviour over and above explicit attitudes (e.g., Greenwald et al., 2009). The findings imply that spontaneous processes, tapped by implicit attitudes, are important in dictating behaviour along with more deliberative, controlled processes, tapped by explicit attitudes (see Fazio, 1990a). Additionally, it is worth noting that the explicit and implicit attitude measures of bi-dimensional attitudes were uncorrelated in this study, indicating that the measures tapped conceptually different types of attitudes that independently predicted behaviour, consistent with research on unidimensional attitudes (see Perugini, 2005; T. D. Wilson, Lindsey, & Schooler, 2000).

Also in support of a rejection of the null for hypothesis 2, the positive dimension of implicit attitude was a significantly stronger independent predictor of speeding behaviour than was the negative dimension. The results demonstrate for the first time that a positivity bias is found with implicit bi-dimensional attitudes, meaning that the positivity bias is not exclusive to explicit bi-dimensional attitudes. The implication is that behaviour is dictated by evaluations of positive behavioural outcomes at the expense of the negative behavioural outcomes at both the explicit level of cognitive functioning (i.e. when an individual has the motivation and opportunity to think about what action to take) and the implicit level (i.e., when behaviour is more reactive or automatic).

The positivity bias that was found with regards to implicit bi-dimensional attitudes is particularly important because bi-dimensional attitudes have been measured in previous research using self-reported questionnaires, which can be criticized for being susceptible to cognitive (Murdock, 1962), affective (Mayer et al., 1995) and self-presentation biases (e.g., Gur & Sackeim, 1979; Paulhus & Reid, 1991). On the other hand, measures of implicit attitudes from IATs are less vulnerable to these criticisms (e.g., Banse et al., 2001). The positivity bias found in previous studies of explicit bi-dimensional attitudes, with the positive dimension predicting speeding behaviour to a significantly greater extent than the negative dimension (e.g., Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018), can therefore be held with greater confidence.

The finding that the positive dimensions of both explicit and implicit attitudes predicted speeding behaviour, whereas the negative dimensions did not, has important implications for interventions that aim to change behaviour through attitude-change (e.g., induced compliance interventions). The finding suggests that interventions should focus on explicit and implicit attitudes and only the positive dimension of both types of attitude (i.e., if they decrease the extent to which drivers both explicitly and implicitly evaluate the positive attributes of speeding as being positive). The finding that the negative dimensions of both explicit and implicit attitudes did not independently predict speeding suggests that behaviour-change interventions are likely to be met with limited success if they target only those attitude dimensions (i.e., if they increase the extent to which drivers both explicitly and implicitly evaluate the negative attributes of speeding as being negative). This is in line with the interventions reviewed in chapter 1 (Department for Transport, 2013b; Ipsos MORI. et al., 2018; Stead et al., 2004) and chapter 2 (Brijs et al., 2014; Cuenen et al., 2016; Elliott & Armitage, 2009; Glendon et al., 2014; Goldenbeld et al., 2008; Lang et al., 2010; Meadows & Stradling, 1999; Parker et al., 1996; Poulter & McKenna, 2010; Stead et al., 2004) which have typically focused on the negative outcomes of speeding and generally been found to be ineffective at modifying driving behaviour and crash-risk (Helman, Grayson, & Parkes, 2010; Kinnear et al., 2013). The induced compliance intervention developed in this programme of research was therefore designed to primarily target the positive dimensions of attitudes (see chapter 5).

4.5.2 Suitability of the measures of attitudes and behaviour for use in subsequent studies

This study was also conducted to develop and assess the suitability of the key measures of attitudes and behaviour that could be used in the subsequently reported studies in which induced compliance (chapter 5) and hypocrisy induction (chapter 6), cognitive dissonance-based interventions were tested. The Cronbach's alphas (see Table 4.3) for the measures of explicit attitudes (both the positive and negative dimensions) were above $\alpha = 0.70$, which is the accepted criterion in the social sciences for demonstrating good internal reliability (e.g., Cronbach, 1951; Nunnally, 1978). The Cronbach's alphas for the measures of implicit attitudes were between $\alpha = 0.60$ and $\alpha = 0.70$, which indicates acceptable internal reliability (e.g., Kline, 2000), and in the case of the positive dimension of implicit attitude, the Cronbach's alpha was very close to $\alpha = 0.70$ ($\alpha = 0.69$). Additionally, the correlation between the positive and negative dimensions of explicit attitudes was below $r = .70$, which is the conventionally accepted criterion for demonstrating independence amongst constructs and thus discriminant validity (Tabachnick & Fidell, 1996). Similarly, the positive and negative dimensions of implicit attitudes were independent because they were not correlated significantly and neither of the explicit attitude measures correlated with the implicit measures, further supporting the discriminant validity of the measures employed in this study (see Table 4.3). Finally, the bi-dimensional attitude measures in the study were found to predict speeding on the simulator (see above) and therefore they also possessed predictive validity. Furthermore, the predictive validities of the attitude measures were stable as they were not sensitive to subtle differences between the measures in their internal reliabilities or their variances (see footnote 5). The measures of explicit and implicit bi-dimensional attitudes used in this study were therefore deemed to be psychometrically reliable and valid and therefore suitable for use in the subsequently presented studies.

The behaviour measure can also be deemed suitable for use in the subsequent studies within this PhD programme. As mentioned in the introduction to this chapter, a driving simulator provides a suitable tool for measuring speeding because it allows objective behaviour to be assessed under experimentally controlled conditions, where all participants can be exposed to the same stimuli which, is essential when comparing across experimental conditions. It was not, therefore, possible to use black box technology to capture objective, real-world, measures of speeding behaviour. An important issue to consider, however, is that measures of behaviour from driving simulators have previously been criticised for potentially lacking ecological validity (e.g., Neale & Leibert, 1986). With respect to this issue, and as described in the method section of this chapter (section 4.3.5), it is worth noting that the simulator used in this study has been shown to generate measures of speeding behaviour that significantly correlate with self-reported measures of real-world speeding (McCartan & Elliott, 2018; see section 4.2.5). As also reported in the method section of this chapter, a re-analysis of data collected as part of a previous research project (Brewster et al., 2016), provided evidence that the constructs that typically predict speeding in the real world (e.g., age, driving experience, behavioural intentions, perceived behavioural control and moral norm) also predict speeding on this driving simulator. Furthermore, the mean driving speed of participants on the 30mph speed limited simulator route used in this study was 29 mph, which is comparable to the mean speed (31 mph) on 30mph speed limit roads in the UK (Department for Transport, 2018c). These findings support those from validation studies of driving simulators more generally, which have shown that the results from driving simulator experiments are the same as those from real-world studies of driving (e.g., Helman & Reed, 2015) and mean driving speeds as measured in simulators are comparable to mean driving speeds as measured in the 'real world' (e.g., Lockwood, 1997).

It is also worth noting that the attitude measures in this study were designed to tap attitudes towards speeding in the real world, not the simulator, and they were found to predict driving behaviour on the simulator. It can be argued that these findings provide a type of construct validation (e.g., Brown, 1996). In other words, the behaviour of a measured variable (e.g., speeding in a driving simulator) in accordance with an established theoretical principle (e.g., attitudes are predictors of behaviour) is taken as simultaneously supporting both the established theoretical principle and the measured variable as a proxy for the underlying construct it is aiming to tap (in this case, real-world speed behaviour). The driving simulator route used in this study was therefore deemed suitable for use in the subsequent studies in addition to the measures of attitudes.

4.5.3 Conclusions

This first study in this PhD programme showed that the positive attitude dimension was a stronger predictor of speeding behaviour than was the negative attitude dimension, consistent with the positivity bias found in previous studies of the bi-dimensional attitude-behaviour relationship (e.g., Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018). This was found for explicit attitudes and, for the first time, implicit attitudes. As a result, the induced compliance (attitude-change) intervention developed in the next empirical study was designed to primarily target the positive dimensions of explicit and implicit attitudes and its effectiveness was primarily judged by the extent to which it changed the positive attitude dimensions (i.e., reduced positive evaluations of the positive attributes of speeding) and concordant speeding behaviour. In addition, the research presented in this chapter developed the key measures of attitudes and behaviour that could be used in the subsequently reported studies to test the effectiveness of the cognitive dissonance-based intervention: induced compliance (chapter 5) and hypocrisy induction (chapter 6). The measures of attitudes were found to possess internal reliability and discriminant and predictive validity. The behaviour measure from the simulator was judged to correspond well with measures of real-world speeding behaviour. The measures were therefore deemed suitable for use in the subsequent studies.

Chapter 5: Study 2: Using an induced compliance intervention to change drivers' attitudes towards speeding and reduce speeding behaviour[6]

5.1 Abstract

The aim of this study was to test an induced compliance intervention in a sample of drivers with pro-speeding attitudes. Specifically, the aim of this study was to test an induced compliance intervention that was designed to induce cognitive dissonance and thereby change the positive dimensions of drivers' explicit and implicit attitudes towards speeding and their subsequent speeding behaviour. The participants (n=153 drivers with pro-speeding attitudes) completed pre-intervention measures of explicit bi-dimensional attitudes, self-reported speeding behaviour, and cognitive dissonance. They were then randomised to either an experimental or control condition. The participants in the experimental condition (n=76) were asked to complete the induced compliance intervention, and the participants randomised to the control condition were asked to complete the control intervention. All participants then completed immediate post-intervention measures of cognitive dissonance, explicit bi-dimensional attitudes, and implicit bi-dimensional attitudes. They also drove on a driving simulator to obtain an immediate post-intervention

[6] The research reported in this chapter has been presented at: the 29th International Conference on Traffic and Transport Psychology, Montreal, Canada (26-30 June, 2018). This has resulted in the following publication: McCartan, R., & Elliott, M. A. (2018). Using a cognitive dissonance inducing intervention to change drivers' attitudes towards speeding. *Proceedings of the 29th International Congress of Applied Psychology*, Montreal, Canada.

measure of speeding behaviour. One month later, n=86 participants completed one month post-intervention measures of explicit attitudes and self-reported speeding behaviour. As expected, the intervention engendered cognitive dissonance and engendered a change in the components of attitudes that were found to be the biggest predictors of speeding in study 1 at both immediate and one-month post-intervention. It also reduced one-month post-intervention (self-reported) speeding. Although the intervention did not result in immediate post-intervention (objective) behaviour-change and the changes in attitudes were not attributable to the changes in cognitive dissonance, the one-month post-intervention behaviour-change was attributable to attitude-change.

5.2 Introduction

The research reported in this chapter focused on testing an induced compliance intervention that was designed to change drivers’ attitudes towards speeding through the induction of cognitive dissonance. Recall in chapter 3 that the induced compliance paradigm (Festinger & Carlsmith, 1959) provides an intervention technique that can be used to change people’s attitudes and behaviour. As mentioned in chapter 3, an induced compliance intervention requires participants to complete a ‘counter-attitudinal advocacy task’, during which they are asked to perform a behaviour that is inconsistent with their current attitudes. For example, drivers who currently speed and who hold positive (i.e., unsafe) attitudes towards speeding (e.g. “speeding is beneficial”) could be given a counter-attitudinal advocacy task that requires them to argue that speeding is not beneficial. The discrepancy between the participants’ attitudes and their performed counter-attitudinal behaviour (e.g., arguing that speeding is not beneficial) is theorised to result in feelings of dissonance (Festinger & Carlsmith, 1959). Since the participants cannot go back and change their counter-attitudinal behaviour, it is proposed that they will reduce the resulting dissonance through attitude-change so that their attitudes fall in line with the performed counter-attitudinal behaviour (e.g., the afore-mentioned drivers would be motivated to adopt less positive or negative [i.e., safer] attitudes towards speeding). That attitude change is then predicted to generate a change in subsequent behaviour (e.g., the afore-mentioned drivers would be expected to decrease their speeding behaviour). As discussed in chapter 3, the induced compliance paradigm, therefore, provides a technique that has the potential to help reduce speeding behaviour by changing driver's attitudes.

Although no previous studies have tested the effects of induced compliance interventions on driving behaviour, previous research has shown that induced compliance interventions can be effective at changing attitudes towards other social behaviours (see chapter 3). It was also concluded in chapter 3 that induced compliance interventions are likely to be effective at reducing speeding behaviour because they address the key limitations with previous road safety educational initiatives. As discussed in chapter 3, induced compliance interventions are grounded in theoretical processes of attitude- and behaviour-change (i.e., cognitive dissonance theory) rather than intuition. Also, these interventions are held to change attitudes and behaviour through direct experience (i.e., unpleasant feelings of cognitive dissonance that result from participants own counter-attitudinal behaviour) rather than indirect experience (e.g., passively learning from second-hand sources that speeding can result in increased traffic crash-risk or getting caught by the police). Additionally, it was discussed in chapter 3 that previous interventions have typically focused on the negative dimension of attitudes (i.e., by encouraging drivers to perceive speeding as more negative than they currently do), rather than the positive dimension (i.e., by encouraging drivers to perceive speeding as less positive than they currently do), and only on explicit attitudes, rather than implicit attitudes. However, study 1 (chapter 4) showed that the positive dimensions of both explicit and implicit attitudes independently predicted speeding behaviour, whereas the negative dimensions did not, implying that reductions in speeding are perhaps best achieved by primarily targeting interventions at the positive rather than the negative dimension of attitudes and at both explicit and implicit attitudes. Therefore, study 2, reported in this chapter, aimed to develop and test an induced compliance intervention that focused primarily on changing the positive dimensions of both explicit and implicit attitudes towards speeding, with the aim to reducing subsequent speeding behaviour.

In addition, study 2 was designed to address some of the key limitations of previous research on other social behaviours. As discussed in chapter 3, induced compliance interventions, which are designed to change deviant behaviour by changing undesirable attitudes, have typically been tested using samples that have not been screened to ensure that the participants all hold undesirable attitudes and engage in the problem behaviour in the first place. This means that the effectiveness of the interventions tested in previous studies might have been underestimated because there was little scope to change potentially many participants' attitudes and behaviour for the better. Therefore, the study reported in this chapter screened the participants in order to ensure that the induced compliance intervention was tested using a sample of drivers who, prior to the intervention, reported that they exceeded the speed limit regularly (i.e., behaviour-change required) and that they had undesirable attitudes (i.e., attitude-change required).

Additionally, as also discussed in chapter 3, the outcome measures used to test the effectiveness of the induced compliance interventions in many previous studies were problematic because behaviour was measured using self-reports (e.g., Di Bello et al., 2018; Stice et al., 2007). As discussed in chapter 2, self-reported measures of behaviour can be susceptible to various cognitive biases, such as primary and recency effects (Murdock, 1962), affective biases such as mood congruent memory effects (e.g., Mayer et al., 1995) and self-presentation biases such as self-deception (Gur & Sackeim, 1979) and impression management (Paulhus & Reid, 1991). Therefore, the study reported in this chapter employed an objective measure of post-intervention behaviour, in addition to measures of both explicit and implicit attitudes, to better test the effectiveness of the induced compliance intervention.

Next, researchers have typically not included measures of cognitive dissonance in previous studies of induced compliance interventions (Di Bello et al., 2018; Festinger & Carlsmith, 1959; Harmon-Jones et al., 2008; Joule & Martinie, 2008; Leippe & Eisenstadt, 1994; Stice et al., 2007). As discussed in chapter 3, researchers have not therefore often provided explicit tests of whether their induced compliance interventions have generated cognitive dissonance or if the attitude change that followed the induced compliance interventions could be attributed to cognitive dissonance. Instead, researchers have typically assumed that cognitive dissonance has been engendered by the interventions on the basis of attitude- or behaviour- change and that cognitive dissonance has acted as the causal determinant of the attitude- or behaviour- change.

Although cognitive dissonance has been measured in a small number of previous studies of induced compliance interventions, the results have been mixed. For example, in Simmons and Brandon (2007)'s study (reviewed in chapter 3), it was found that the experimental participants who completed an induced compliance intervention designed to change their attitudes towards smoking reported greater post-intervention intentions to quit smoking. The experimental participant also took more antismoking educational pamphlets when leaving the laboratory (indicating a more positive orientation towards quitting smoking) compared to the participants, in two control conditions. However, the experimental participants reported higher levels of cognitive dissonance compared to the participants in one of the control conditions only. Furthermore, Chait (2010) and Simmons, Webb, and Brandon (2004) found changes in participants' attitudes following an induced compliance intervention but found no evidence for an effect of the intervention on cognitive dissonance (Chait, 2010; Simmons et al., 2004). Further research is therefore needed in which cognitive dissonance is measured, in addition to attitude- and behaviour-change, in order to help reach a conclusion about whether induced compliance interventions can generate attitude-change through the induction of cognitive dissonance, in line with theory (Festinger, 1957). The study reported in this chapter, therefore, included measures of cognitive dissonance in order to provide an explicit test of whether any attitude-change following the induced compliance intervention can be attributed to cognitive dissonance.

Finally, given that attitudes are theoretically proposed to causally determine behaviour in most attitude-behaviour models (e.g., Ajzen, 1985; Ajzen, 1991; Fazio & Williams, 1986; Fishbein & Ajzen, 1975; Gibbons & Gerrard, 1995; see chapter 2), an explicit test was provided of whether any behaviour-change, following the intervention, could be attributed to attitude-change. This issue was also deemed to be of theoretical importance given that most previous studies of the attitude-behaviour relationship are correlational (see chapter 2). These studies do not therefore help determine whether attitudes cause people to perform concordant behaviours (i.e., the proposed causality in the theoretical models reviewed in chapter 2), whether behaviour causes people to hold the concordant attitude (i.e., the reverse of the proposed causality) or whether a third unknown variable causes both the attitude and the concordant behaviour and therefore the correlation between the two. Experimental research (e.g., Sheeran et al., 2016; Stice et al., 2007) is therefore needed in which attitudes and behaviour are successfully changed and analyses are conducted to test whether the behaviour change can be attributed to the change in attitudes, in line with many theories of the attitude-behaviour relationship.

To summarise, the primary aim of the research reported in this chapter was to test an induced compliance intervention that was designed to induce cognitive dissonance and thereby change the positive dimensions of drivers' explicit and implicit attitudes towards speeding and their subsequent speeding behaviour. At immediate post-intervention, it was hypothesized that: the participants randomised to the experimental (induced compliance intervention) condition would report significantly greater levels of cognitive dissonance (hypothesis 1), have significantly less positive explicit (hypothesis 2) and implicit (hypothesis 3) attitudes towards speeding, and exceed the speed limit significantly less frequently (hypothesis 4) than would the participants randomised to the control condition. At one-month post-intervention, it was expected that the participants randomised to the experimental condition would still report significantly less positive attitudes (hypothesis 5) and exceed the speed limit significantly less frequently (hypothesis 6) than would the participants randomised to the control condition. It was also hypothesised that the measure of cognitive dissonance would mediate any effects of the intervention on both the immediate (hypothesis 7) and one-month post-intervention (hypothesis 8) attitude measures (i.e., any attitude-change following intervention would be attributable to the induction of cognitive dissonance). Finally, it was hypothesised that any changes in attitudes following intervention would mediate any effects of the intervention on both the immediate (hypothesis 9) and one-month post-intervention (hypothesis 10) behaviour measures (any behaviour-change following intervention would be attributable to attitude-change).

5.3 Method

5.3.1. Participants

N = 153 participants completed both the pre- and immediate-post intervention stages of the study (*n* = 76 in the experimental [intervention] condition and *n* = 77 in the control condition). *N* = 88 participants completed the one-month post-intervention stage of the study (*n* = 42 in the experimental condition and *n* = 46 in the control condition). To maximise the *n* in the subsequent analyses, the full sample (i.e., the *N* =153 participants who completed the pre- and immediate post-intervention stages of the study) was used to test hypotheses 1, 2, 3 4, 7 and 9 (i.e., the hypotheses relating to the immediate post-intervention measures). The subsample (i.e., the *N* = 88 participants who also completed the one-month post-intervention stage) was used to test hypotheses 5, 6, 8 and 10 (i.e., the hypotheses relating to the one-month post-intervention measures). The mean age of the full sample was 25.16 (*SD*=8.29; range= 17-54) and 46.4 % was male (*n*= 71). The mean weekly mileage was 120.16 (*SD*= 139.94; range= 5-800), and the mean number of years that the participants had held a full driving licence for was 6.75 (*SD*= 7.722; range= 0.27-36.08). The mean age of the subsample was 26.25 (*SD*=9.81; range= 17-54) and 39.8 % was male (*n*= 35). The mean weekly mileage was 125.52 (*SD*= 13.12; range= 5-800), and the mean number of years that the participants had been licenced to drive was 7.72 (*SD*= 9.04; range= 0.50-36.08). A series of one-way ANOVAs showed that there were no differences in age, F (1,151) = 3.62, p = .059, weekly mileage, F (1, 151) = 0.30, p = .583, or the number of years licenced to drive, F (1, 151) = 3.36, p = .069, between the participants who completed the pre- and immediate post-intervention stages of the study only (*n* = 65) and those who completed all stages (*n* = 88). A Chi-Square showed that there was no difference between the two groups on sex, χ^2 (1) = 3.66 p = .056. Attrition analyses, reported below (section 5.4.2) also showed that there were no differences between the two groups on the key outcome measures of attitudes and behaviour. There was therefore no evidence that systematic biases were introduced by the approach used to maximise the *N* in the analyses.

5.3.2. Design and Procedure

Ethical approval for conducting this study was awarded by the University's School of Psychological Sciences and Health ethical committee. Data collection for this study was carried out by myself and 3 undergraduate and 1 postgraduate students at the University, under my supervision. In order to make the recruitment process more effective, this study was conducted at the same time as study 3. A randomised control design was used. The participants were recruited through advertisements placed on notice boards around the campus of a large university in the west of Scotland and online posts including advertisements on social networking sites (e.g., Facebook and Twitter) and the virtual learning environment of the university. The advertisements stated that the study was a general-purpose investigation into driver behaviour and attitudes. To avoid a potential bias in the results (i.e., receiving a behaviour change intervention, such as cognitive dissonance inducing interventions, may in itself alter participants' behaviour), participants were not informed the study was about cognitive dissonance interventions. Instead, the advertisements stated that the study was a general-purpose investigation into driver behaviour and attitudes. Embedded within the advertisement was a web-link to an online questionnaire, which contained the participant information sheet (see Appendix D), which again explained that the study was a general purpose investigation into drivers' attitudes towards speeding. The online questionnaire was used to measure demographic information (e.g., age, gender, weekly mileage, number of years licenced to drive), and pre-intervention (self-reported) speeding behaviour and explicit attitudes towards speeding.

The measure of speeding behaviour was a 20-item scale, which has previously been shown to possess good internal reliability and used to successfully test road safety interventions (e.g., Brewster, Elliott, & Kelly, 2015; Brewster et al., 2016). Each item measured how often the participants exceeded the speed limit in a specific situation (see Table 5.2). Both the positive and negative dimensions of explicit attitudes were measured using the standard unipolar bi-dimensional attitude scales that were employed in study 1. A standard bi-polar unidimensional measure of explicit attitudes was also included in the questionnaire to assess how negative to positive the participants evaluated speeding (see section 5.3.5 for a full description of the measures). Along with the pre-intervention measure of speeding behaviour, the purpose of the bi-polar unidimensional attitude measure was to screen the participants to ensure they were eligible to continue with the study. More specifically, the participants were deemed eligible to continue with the study if they reported exceeding the speed limit on a regular enough basis to justify giving them an intervention designed to reduce their speeding behaviour. This was operationally defined as scoring the scale mid-point or above on 5 of more of the behaviour items, meaning that at least moderate levels of speeding behaviour were reported in a quarter of the driving situations that comprised the pre-intervention behaviour measure[7]. In addition, they also had to report having positive attitudes towards speeding, which needed to be changed from a road safety perspective. This was operationally defined as scoring above the scale mid-point on the negative-positive bipolar, unidimensional attitude measure.

N = 673 participants completed the pre-intervention measures of speeding behaviour and explicit attitudes towards speeding. *N* = 226 of these participants met

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[7] A reanalysis of Brewster et al. (2015)'s data was carried out to aid the decision about how best to screen the participants for this study to ensure that the final sample comprised current 'speeders' without being too restrictive and therefore under-sampling from the initial sample and putting the final sample size at undue risk. The reanalysis showed that 74.1% of Brewster et al. (2015)'s sample scored the scale mid-point or higher on five or more of the 20 behaviour items that comprised the pre-intervention behaviour measure 78.6% scored the scale mid-point or more on 4 or more of the behaviour and 68.3% scored the scale mid-point or more on 6 or more of the behaviour items. It was therefore decided that the participants in this study needed to score the scale mid-point or greater on five or more of the behaviour items as it would preserve approximately three-quarters of the initial sample. It was decided that retaining the participants who scored the scale mid-point on fewer than five behaviour items would have preserved too many participants who would not have been appropriate to receive an intervention to reduce speeding and retaining the participants who scored the scale mid-point on more than five behaviour items would have been too restrictive and led to not achieving the required final sample. I thank Sarah Brewster and her colleagues for allowing access to the data from her study.

the eligibility criteria. These participants were therefore contacted, using the email addresses they provided within the questionnaire and invited to the Driver Behaviour Laboratory, situated in the School of Psychological Sciences and Health, to take part in the next stage of the study. N = 153 (67.70%) participants accepted this invitation and visited the laboratory (see Figure 5.1). In addition, as indicated in Figure 5.1, N = 257 participants were not eligible for study 2, but they were eligible for study 3. Therefore, in order to maximise recruitment, these participants were invited to take part in the next stage of study 3 (see chapter 6).

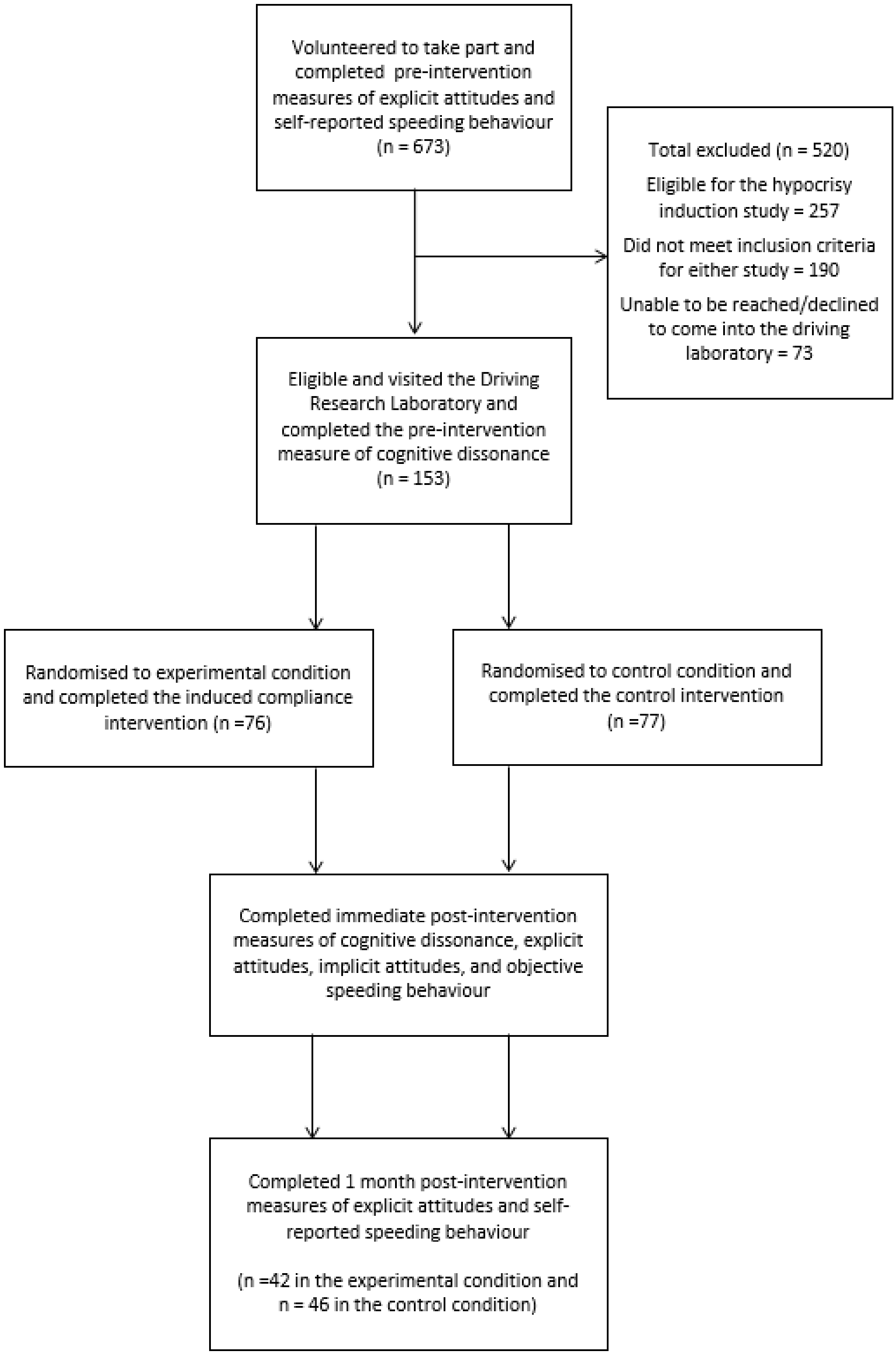

Figure 5.1: Flow chart showing the participants' progress through the study

When the participants arrived at the Driver Behaviour Laboratory, they were asked to complete a short questionnaire designed to measure pre-intervention levels of cognitive dissonance using Elliot and Devine (1994)'s dissonance thermometer (see section 5.3.5). As shown in figure 5.1, the participants were then randomly allocated to either an experimental condition (*n* = 76) or a control condition (*n* = 77). A random number generator was used to assign the participants to the conditions. The participants randomised to the experimental condition were given the induced compliance intervention. In line with the literature on cognitive dissonance, this was a counter-attitudinal advocacy task (see section 5.3.3 below). The participants randomised to the control condition were given a control intervention that was not designed to induce cognitive dissonance (see section 5.3.4 below). Immediately post-intervention, all of the participants completed a questionnaire that contained the same items as used at pre-intervention to measure their cognitive dissonance. They also completed a questionnaire containing the same items as used at pre-intervention to measure both the positive and negative dimensions of their explicit attitudes towards speeding and the two IATs that were developed in study 1, to measure the positive and negative dimensions of their implicit attitudes towards speeding. Following study 1, potential order effects were controlled by asking half of the participants to complete the attitude questionnaire first and the other half were asked to complete the IATs first. Similarly, half the participants completed the IAT to measure the positive attitude dimension first and the other half completed the IAT to measure the negative attitude dimension first. Following the questionnaires and IATs, all of the participants drove on a driving simulator to obtain an objective measure of speeding behaviour immediately after the intervention.

One month post-intervention, all of the participants who attended the Driving Research Laboratory were sent a link to an online follow-up questionnaire. This questionnaire contained the same items as at pre- and immediate post-intervention to measure the positive and negative dimensions of explicit attitudes towards speeding and the same items as at pre-intervention to measure self-reported speeding behaviour. After completing this questionnaire, participants were thanked for taking part, were debriefed fully about the study, and were given the opportunity to withdraw their data because of the deception involved in the study. No participants opted to withdraw their data. The rationale for having a one-month follow-up for this study was because previous research demonstrates that cognitive dissonance effects can last for up to two weeks post-intervention (e.g., Draycott & Dabbs, 1998), however there is a risk of reversion back to pre-intervention attitudes or behaviour (e.g., Olson & Stone, 2005). This, therefore, means that a follow-up of 2 weeks or less may not accurately capture the long-term effects of the intervention. Also, research demonstrates that effects found after 1 month typically persist over time (e.g., Armitage, 2005), therefore, a one-month follow-up was deemed appropriate to test the long-term effects of the intervention.

As shown in Figure 5.1, n = 88 participants (57.52%) completed the one-month post-intervention measures (n = 42 in the experimental condition and n = 46 in the control condition). The data that were collected across the three stages of the study (pre-, immediate post- and one-month post- intervention) were matched by using unique identifiers that were given to each participant on all questionnaires and driving simulator databases. The participants who were recruited from the University and formed part of the Psychology Participant Pool (years 1, 2 and 3 of the BA

Psychology degree programme) received a course credit for participation in the research. All other participants received no incentive for taking part.

In order to make the recruitment process more effective, this study was conducted at the same time as study 3. Specifically, as indicated in Figure 5.1, N = 257 participants were not eligible for study 2, but they were eligible for study 3. Therefore, in order to maximise recruitment, these participants were assigned to study 3 (see chapter 6).

5.3.3. The Induced Compliance Intervention

The participants randomised to the experimental condition were given a counter-attitudinal advocacy task. First, the participants were told that their scores on the initial online questionnaire showed that they viewed speeding favourably (i.e., they had positive attitudes towards speeding) but that they exceeded the speed limit, at least on occasion. Next, the participants were told that, because of this, their help was needed to identify persuasive arguments that could be used in road safety materials to convince drivers like them not to speed. To help them do this, they were shown a list of nine reasons that drivers often give for why they view speeding as a positive behaviour and asked to select up to three of these reasons for why they personally think that exceeding the speed limit is desirable[8]. The nine reasons presented to the participants are summarised in Table 5.1 and were derived from the literature on driver behaviour in which researchers have identified the most common

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[8] The majority of the participants selected three reasons (92%), with only 8% selecting two reasons.

perceived consequences of speeding (e.g., Elliott, Armitage, & Baughan, 2005; Kanellaidis, Golias, & Zarifopoulos, 1995; Parker et al., 1992).

Table 5.1 Counter-attitudinal advocacy task statements

Reasons for speeding	Counter-positions to be argued
My speeding does not put pedestrians at risk	Speeding does put pedestrians at risk
My speeding does not increase my chances of an accident	Speeding does increase my chances of an accident
Speeding allows me to keep up with traffic	It isn't that important to keep up with the surrounding traffic if it is moving faster than the speed limit
Speeding means that I won't hold up the traffic	Keeping to the speed limit does not actually hold up the traffic
Speeding allows me to reach my destination quicker	Speeding does not always allow me to reach my destination quicker
Speeding stops me from feeling annoyed while driving	You can stop yourself from feeling annoyed even if you comply with the speed limit
Speeding does not make me feel unsafe	Speeding is an unsafe behaviour
My speeding does not stop me from being able to detect hazards on the road	Speeding makes it harder to detect hazards while driving
Speeding makes me feel in control of my vehicle/comfortable while driving	You are more likely to lose control of your vehicle if you drive faster than the speed limit

Each of these consequences was phrased such that it focused on a positive aspect of speeding, even if the consequence referred to a negative aspect of speeding. For example, one negative consequence of speeding commonly mentioned by drivers is that ‘it will increase the risk of an accident’. This consequence was therefore converted to ‘My speeding does not increase my chances of an accident’. This was designed to help ensure that the induced compliance intervention focused the participants on the positive rather than negative dimensions of their attitudes, which was important given that study 1 showed that only this attitude dimension predicted speeding and therefore needed to be primarily targeted by the attitude-change intervention. Each reason for speeding had a corresponding ‘counter-position to be argued’ (see Table 5.1). The participants were told that:

> ‘Now you have selected the reasons for why you think speeding is a positive behaviour, we would like you to try to come up with some counter-arguments. Imagine that another driver has the same reasons as you do for believing speeding is a positive behaviour. Your job is to convince this driver they are wrong. What would you say to them? What would your arguments be?’

This meant that the focus of the intervention was primarily on reducing the positivity of the positive dimension of attitudes rather than increasing the negativity of the negative dimension of attitudes (i.e., the participants had to argue that speeding was not positive rather than why it might be negative). The participants were asked to write down each of their counter-arguments providing as much detail as possible.

The rationale for asking the participants to develop counter-arguments for up to three reasons for speeding was based on previous research showing that intervention components compete for participants' attentional resources (e.g., Webb, 2006). This means that too many intervention components (in this case counter-arguments generated by the participants) can deplete the attentional resources that can be devoted to any one component, thus increasing the risk of inadequate cognitive processing of all components. In the present context, this would be likely to reduce the likelihood of cognitive dissonance, and in turn attitude-change.

On the other hand, it is well established in several models of attitudes (e.g., Fishbein, 1963) that attitudes are formed on the basis of underlying beliefs. For example, a positive attitude towards speeding comes from holding beliefs that positive consequences, such as 'getting to one's destination quickly', are likely to occur and negative consequences, such as 'having a traffic accident', are not (e.g., Elliott et al., 2005; Rowe et al., 2016). Asking the participants to argue against just one reason for speeding, and thus challenge just one of the potentially many beliefs that contribute towards their attitudes might not therefore invoke sufficient cognitive dissonance to motivate attitude-change. Asking the participants to challenge multiple beliefs that are in favour of speeding is likely to invoke greater cognitive dissonance because more weight is being given towards an argument that directly contradicts their attitudes.

Additionally, it was decided that the intervention should require multiple counter-arguments to be generated because, while a counter-attitudinal advocacy task is likely to target explicit attitudes through deliberative counter-attitudinal behaviour (see chapter 3), implicit attitudes are also important in the prediction of speeding (see study 1). Asking participants to make multiple arguments for why speeding is not positive increases the likelihood that the target behaviour (i.e., speeding) becomes paired with the required evaluation (i.e., not positive) on a repeated basis. As discussed in chapter 3, this increases the likelihood that the association between the behaviour and the evaluation of it (i.e., the attitude) will become implicitly encoded in memory to a greater extent (e.g., Olson & Fazio, 2006; Rydell & McConnell, 2006) which should increase the likelihood of influencing implicit attitudes in addition to explicit attitudes (e.g., Rydell & McConnell, 2006). For these reasons, it was decided that asking the participants to select and generate up to three counter-arguments was appropriate.

Prior to completing the counter-attitudinal advocacy task, the participants were given the cover story that their counter-arguments would be used in road safety materials that were being developed on the basis of this research. In addition, they were told that their counter-arguments would be shown to a panel of drivers who would be rating them for persuasiveness. The participants were told that the panel would consist of drivers who, like them, had favourable attitudes towards speeding and therefore the counter-arguments needed to be convincing in order to have a chance of persuading them. For that reason, a researcher read the participants' counter-arguments back to them and discussed their ideas for how to make each one as convincing as possible. The rationale for this procedure came from the previous research reviewed in chapter 3 showing that induced compliance interventions in other domains have been successful at changing attitudes so long as counter-attitudinal behaviour (e.g., making persuasive arguments that contradict attitudes) is performed publicly (i.e., in front of others) rather than privately. The above mentioned cover story and the discussion of the counter-arguments with the researcher was designed to increase the public nature of the task. The discussion with the researcher also provided additional opportunity for the association between the act of speeding and the required evaluation (not positive) to be re-enforced, thus increasing the likelihood that the intervention would target implicit in addition to explicit attitudes (see above). The participant was free to add to their written counter-arguments if they wished based on the content of the discussion with the researcher.

The participants were also told, prior to receiving the induced compliance intervention, that they did not have to complete the task if they did not want to. The participants from the Psychology Participant Pool were additionally told that they would still receive full course credits should they decide not to complete the intervention task. This was not only for ethical reasons (The British Psychological Society, 2018), but also because previous research in other domains (see chapter 3) has shown that induced compliance interventions have been successful at changing attitudes so long as the motivation to complete the counter-attitudinal advocacy task cannot be attributed to receiving an incentive or having no choice (i.e., an external cause). Instead, the behaviour that is performed in the counter-attitudinal task must be freely chosen (i.e., internally attributed).

5.3.4 The Control Intervention

The participants randomised to the control condition were given a task that was not designed to induce cognitive dissonance. Specifically, the participants randomised to the control condition were asked to read a road safety information sheet about the effects of speeding and its role in traffic accidents. This information sheet was based on an intervention developed by Elliott and Armitage (2009) which targeted attitudes and other social cognitive constructs (see chapter 2). The intervention comprised a 1-page information sheet about the benefits of keeping to

30mph speed limits and persuasive messages designed to deter drivers from speeding. The information sheet contained arguments for why keeping to 30mph speed limits reduces the risk of a traffic accident and injury to pedestrians, why it makes it easier to detect hazards, why it does not make it difficult to keep up with surrounding traffic and why it makes drivers feel more relaxed and use less fuel. Elliott and Armitage (2009) found that these arguments did not engender a change in participants' attitudes. Therefore, they were deemed appropriate for use in the control condition in this study. More generally, it was deemed appropriate to include an intervention in the control condition to help rule out a demand effect as a possible explanation for any attitude- or behaviour-change following the induced compliance intervention (e.g., Rosenthal & Jacobson, 1966).

5.3.5 Measures

5.3.5.1 Cognitive dissonance

Cognitive dissonance was measured at both pre- and immediate post-intervention using the dissonance thermometer (Elliot & Devine, 1994). In line with Elliot and Devine (1994), the participants were asked to "Please indicate how you are feeling right now". They were then presented with three target items that measure cognitive dissonance (uneasy, bothered and uncomfortable) amongst 12 other items (see Appendix E). The participants responded to each item on a 9-point scale from "Does not apply at all" (scored 1) to "Applies very much" (scored 9). The mean of the three target items was calculated and used as the final measure of cognitive dissonance at both pre-intervention (Cronbach's $\alpha = 0.54$) and immediate post-intervention (Cronbach's $\alpha = 0.83$).

5.3.5.2 Explicit Attitudes

As in study 1, the split semantic differential technique (Kaplan, 1972) was used to measure the positive and negative dimensions of explicit (bi-dimensional) attitudes. Six items were used to measure the positive dimension of explicit attitudes. The participants were asked to (1) “Think only about the fun outcomes that you associate with speeding” and to rate “How fun are they?”; (2) “Think only about the enjoyable outcomes that you associate with speeding” and to rate “How enjoyable are they?”, (3) “Think only about the rewarding outcomes that you associate with speeding” and to rate “How rewarding are they?”; (4) “Think only about the pleasant outcomes that you associate with speeding” and to rate “How pleasant are they?”, (5) “Think only about the beneficial outcomes that you associate with speeding” and to rate “How beneficial are they?”; (6) “Think only about the positive outcomes that you associate with speeding” and to rate “How positive are they?”. The participants’ ratings were provided on 9-point unipolar scales, for example, from “not at all fun (scored 1) to “extremely fun” (scored 9). The mean of the six items was calculated and used as the final measure of the explicit positive attitude dimension at pre-intervention (Cronbach’s α = 0.79), immediate post-intervention (Cronbach’s α = 0.87) and one-month post-intervention (Cronbach’s α = 0.88). Higher scores indicated that the positive outcomes of speeding were rated more positively.

Six items were also used to measure the negative dimension of attitude. The participants were asked to (1) “Think only about the boring outcomes that you associate with speeding” and to rate “How boring are they?”; (2) “Think only about the unenjoyable outcomes that you associate with speeding” and to rate “How unenjoyable are they?”, (3) “Think only about the unrewarding outcomes that you associate with speeding” and to rate “How unrewarding are they?”; (4) “Think only about the unpleasant outcomes that you associate with speeding” and to rate “How unpleasant are they?”, (5) “Think only about the harmful outcomes that you associate with speeding” and to rate “How harmful are they?”; (6) “Think only about the negative outcomes that you associate with speeding” and to rate “How negative are they?”. The participants’ ratings were provided on 9-point unipolar scales, for example, from “not at all boring (scored 1) to “extremely boring” (scored 9). The mean of the six items was calculated and used as the final measure of the explicit negative attitude dimension at pre-intervention (Cronbach’s $\alpha = 0.71$), immediate post-intervention (Cronbach’s $\alpha = 0.75$) and one-month post-intervention (Cronbach’s $\alpha = 0.76$). Higher scores indicated that the negative outcomes of speeding were rated more negatively.

As reported in section 5.3.2, a pre-intervention measure of unidimensional attitudes towards speeding was also taken and used solely for the purpose of screening the participants (see section 5.3.2). The rationale for using this measure to screen the participants was because it was not possible to do so using the pre-intervention measure of bi-dimensional attitudes. Specifically, a single measure was needed to be able to categorise the participants to the appropriate intervention, meaning that a single, unidimensional measure was required. Standard questionnaire items (i.e., commonly employed in the literature and shown to produce reliable measures) were used. The participants were asked to respond to six items using 9-point scales. The participants were presented with the item stem: “For me, speeding whilst driving over the next month would be…” They were asked to complete the stem using bipolar semantic differential scales from “extremely boring” (scored 1) to "extremely fun" (scored 9); from "extremely unenjoyable" (scored 1) to "extremely enjoyable" (scored 9); from "extremely unrewarding" (scored 1) to "extremely rewarding" (scored 9); from "extremely unpleasant" (scored 1) to "extremely pleasant" (scored 9); from "extremely harmful" (scored 1) to "extremely beneficial" (scored 9); and from "extremely negative" (scored 1) to "extremely positive" (scored 9). The mean of the six items was calculated and used to screen the participants as described in section 5.3.2 (Cronbach's alpha of $\alpha = 0.61$).

5.3.5.3 The bi-dimensional implicit attitudes measures

The positive and negative dimensions of implicit attitudes were measured using the IATs that was developed in study 1. The Cronbach's alphas for version 1 and 2 of the IAT measuring the positive dimension of attitudes (see chapter 4, section 4.3.4 for details about versions 1 and 2) were $\alpha = 0.65$ and $\alpha = 0.72$, respectively. This meant that the Cronbach's alpha for the overall measure of the positive dimension of implicit attitudes was $\alpha = .69$. The Cronbach's alphas for version 1 and 2 of the IAT measuring the negative dimension of attitudes were $\alpha = 0.64$ and $\alpha = 0.63$, respectively. This meant that the Cronbach's alpha for the overall measure of the positive dimension of implicit attitudes was $\alpha = .64$. Higher scores on these measures indicated more positive or negative attitudes towards speeding (see chapter 4; section 4.3.4).

Table 5.2 List of 20 driving situations

Driving situations
Driving when I am being overtaken by other traffic/another vehicle
Driving when I am trying to keep up with surrounding traffic
Driving when I feel under pressure from another driver following close behind me
Driving when another driver is putting pressure on me to drive faster by flashing their headlights/sounding their horn
Driving after I have been 'stuck' in stationary traffic
Driving after I have been 'stuck' behind a slow moving vehicle
Driving on roads with little or no traffic
Driving when traffic lights have just turned against me
Driving on roads that I think should have higher speed limits
Driving when I am listening to certain types of music in the car
Driving on a long journey
Driving when I feel stressed
Driving when I am carrying passengers who are encouraging me to drive faster (overtly or otherwise)
Driving when I feel like showing-off or asserting myself
Driving when I am late or in a hurry to get somewhere (e.g., work/university/an appointment/to meet friends
Driving on familiar roads
Driving when I feel like there is little chance of being caught for speeding
Driving when I feel like the car 'wants' to go faster
Driving past a school
Driving down a road with parked cars

5.3.5.4 Speeding behaviour

Speeding behaviour was measured at pre-intervention and one-month post-intervention using a self-reported scale comprising of 20 items that asked participants to indicate how often they exceed the speed limit in a comprehensive range of driving situations as identified from the literature on road safety (see Brewster et al., 2015). The participants were asked: "When you encounter the following situations, how often do you find yourself driving faster than the speed limit?" They were then presented with the 20 driving situations, shown in Table 5.2.

The participants indicated their responses on scales ranging from 1 (never) to 9 (very often). The mean of the 20 items provided a reliable measure of speeding behaviour at pre-intervention (Cronbach's $\alpha = 0.80$) and one-month post-intervention (Cronbach's $\alpha = 0.89$).

At immediate post-intervention, speeding behaviour was measured using a driving simulator. The driving simulator used in this study was the same STISIM Drive Model 400W fixed-based driving simulator used in study 1 (see chapter 4, section 4.3.5 and see Appendix C). The trial route and the procedure for collecting the data, including a 5-minute practice drive prior to the trial route proper, was the same as in study 1. Specifically, the participants were initially given a five-minute practice drive to get used to the simulator controls. Following the practice drive, the participants completed the trial route, which comprised a 7.06-mile section of road through an urban environment. Prior to driving the trial route, the participants were told to treat the drive as if it were a real drive in the real world. They were told that the speed limit was 30mph and to drive straight ahead (i.e., not to turn at any junctions). The trial route comprised junctions, zebra crossings, and traffic modelled in the oncoming lane in order to increase the fidelity of the drive. No traffic were modelled in the driving lane and no pedestrians were programmed to cross the road at any of the zebra crossings, allowing participants to freely choose their driving speed without constraint. The measure of speeding behaviour used in the data analysis was the percentage of the trial route that the participants spent driving over the 30mph speed limit. As in study 1, this was operationalised as 30.50mph in order to prevent micro-fluctuations in speed around 30mph from unduly influencing the results. The mean speed for each participant was also extracted from the simulator as an additional behaviour measure.

Note that it was not possible to collect self-report data on speeding immediate post-intervention because the participants had not yet had the opportunity to drive. It was also not feasible within the scope of the research programme reported in this thesis to collect objective data on the participants speeding behaviour more than once. It was decided that immediate post-intervention was the most appropriate time to collect the driving simulator data rather than one-month post-intervention. This was because asking the participants to return to the Driving Simulator Laboratory at one-month post-intervention would have been likely to incur a greater level of attrition than would asking them to complete a self-reported questionnaire and this would have put the sample size achieved in this study at greater risk.

5.3.6 Statistical analysis

Data analysis was conducted using SPSS statistical analysis software. To determine if there were any effects of attrition, a series of one-way ANOVAs were conducted to test the differences between the groups (e.g., the difference between those who dropped out of the study following the pre-intervention and those who completed the next stage). In addition, to determine if randomisation to conditions had been successful, a series of one-way ANOVAs were conducted to test the differences between the conditions on measures of attitude, behaviour, and cognitive dissonance. Also, in order to establish if there were any interaction effects between attrition and conditions, a series of two-way ANOVAs was also conducted to allow the interaction between groups and condition to be tested.

A series of ANOVAs were conducted to establish if there were differences between the experimental and control conditions on the immediate post-intervention measure of cognitive dissonance, and the immediate and one-month post-intervention measures of attitudes and behaviour. The rationale for using these one-way ANOVAs was that it allowed the differences between groups to be statistically tested (i.e., to test hypothesis 1 to hypothesis 6), and did not produce information that was not required (e.g., interactions between different variables).

Mediation analysis was conducted using model 4 of the PROCESS add-on for SPSS (Hayes, 2009) as this is the most widely used technique for testing mediation effects and was therefore appropriate for testing hypothesis 7 to hypothesis 10).

5.4 Results

5.4.1. Power analysis

Power analysis indicated that the sample size required to detect a meaningful sized effect (*d*= .50) at $\alpha = 0.05$ with power = 0.80, was $n = 102$. The present study was therefore sufficiently powered for testing the hypotheses relating to pre- and immediate-post intervention measures (hypotheses 1 to, 2, 3, 4, 7 and 9) without unduly risking a type 1 error because the number of participants who completed the pre- and immediate post-intervention measures was $n = 153$ (see Figure 5.1). The number of participants who completed the one-month post-intervention measures was n = 88 (see Figure 5.1), which was close to the required sample size. I return to this issue in the discussion section of this chapter.

5.4.2. Tests of attrition and randomisation to conditions

As described in the method, n = 226 participants were recruited for this study and completed a pre-intervention questionnaire to measure the positive and negative dimensions of their explicit attitudes towards speeding and their self-reported speeding behaviour. N = 153 of these participants accepted the invitation to the Driving Research Laboratory to take part in the next stage of the study. These participants comprised the full sample, which was used to test the hypotheses relating to the immediate post-intervention measures (see participants section). Three one-way ANOVAs were therefore conducted to test whether there were any observed effects of attrition on the full sample. The dependent variables were the pre-intervention measures of the positive (ANOVA 1) and negative (ANOVA 2) explicit attitude dimensions and pre-intervention measure of (self-reported) speeding behaviour (ANOVA 3). The independent variable in each ANOVA was attrition (0 = dropped out of study following the pre-intervention questionnaire [n = 73]; 1 = completed the next stage [n = 153]). As shown in Table 5.3.1, there were no differences between the study drop-outs following the pre-intervention questionnaire and the study remainers on the pre-intervention measures of the negative dimension of explicit attitudes or self-reported speeding behaviour, meaning that there were no observed pre- to immediate post-intervention attrition-related biases with regards to these measures. However, there was a significant difference between the study drop-outs and remainers on the measure of the positive dimension of explicit attitudes.

The participants who remained in the study at immediate post-intervention rated the positive outcomes of speeding more positively (M = 5.81 SD = 1.20) than did those who dropped out (M = 5.40; SD = 1.28). I return to this issue in the discussion section of this chapter.

Table 5.3.1. Tests of attrition and condition for the full sample of participants who completed the immediate post-intervention stage of the study

Dependent Variable	*F*	MS	*p*	Cohen's *D*
Attrition (0 = Completed baseline only [73]; 1 = Completed baseline and intervention [153])				
Pre-intervention positive dimension of explicit attitudes	5.45	8.20	0.020	0.33
Pre-intervention negative dimension of explicit attitudes	2.57	4.72	0.110	0.22
Pre-intervention speeding behaviour	0.83	0.87	0.364	0.12
Pre-intervention cognitive dissonance*	N/A	N/A	N/A	N/A
Completed baseline and intervention and randomised to Condition (0=control [76]; 1 = experimental [77])				
Pre-intervention positive dimension of explicit attitudes	1.43	2.05	0.233	0.19
Pre-intervention negative dimension of explicit attitudes	0.001	0.002	0.972	<0.001
Pre-intervention speeding behaviour	3.42	3.28	0.066	0.31
Pre-intervention cognitive dissonance	0.07	0.05	0.792	0.05

*Note: the study drop outs at immediate post-intervention could not be compared with the participants who remained in the study at this stage because, unlike the other pre-intervention measures, cognitive dissonance was not measured until immediately prior to intervention, within the same session as intervention delivery and immediate post-intervention measurement (see method section).

The n = 153 participants who accepted the invitation to the Driving Research Laboratory completed a pre-intervention measure of cognitive dissonance and were randomised to either the experimental (n = 76) or control (n = 77) condition. They also completed post-intervention measures of cognitive dissonance, explicit and implicit attitudes (positive and negative dimensions of both) and objective speeding behaviour on the driving simulator. N = 89 (n = 42 experimental and n = 46 control) participants completed the one-month post-intervention stage of the study. These participants comprised the subsample, which was used to test the hypotheses relating to the one-month post-intervention measures (see participants section). A series of one-way ANOVAs was therefore conducted to test whether there were any observed effects of attrition on the subsample. Nine one-way ANOVAs were conducted in total. The dependent variables were the pre-intervention measures of the positive (ANOVA 1) and negative (ANOVA 2) dimensions of explicit attitudes, self-reported speeding behaviour (ANOVA 3) and cognitive dissonance (ANOVA 4), and the immediate post-intervention measures of the positive (ANOVA 5) and negative (ANOVA 6) dimensions of explicit attitudes, the positive (ANOVA 7) and negative (ANOVA 8) dimensions of implicit attitudes and objectively measured speeding behaviour on the driving simulator (ANOVA 9). The independent variable in each ANOVA was attrition (0 = dropped out of study following immediate post-intervention; 1 = completed the study). As shown in Table 5.3.2, there were no significant differences between those who dropped out of the study following the immediate post-intervention stage and those who completed the study, meaning that no attrition-related biases from immediate post- to one-month post-intervention were observed.

Table 5.3.2. Tests of attrition and condition for the one-month post-intervention subsample

Dependent Variable	*F*	MS	*p*	Cohen's *D*
Attrition (0 = Completed baseline and intervention only [65]; 1 = Completed baseline intervention and follow-up [88])				
Pre-intervention positive dimension of explicit attitudes	1.08	1.54	0.301	0.18
Pre-intervention negative dimension of explicit attitudes	0.18	0.31	0.668	0.07
Pre-intervention speeding behaviour	0.18	0.18	0.670	0.06
Pre-intervention cognitive dissonance	0.07	0.06	0.788	0.05
Immediate post-intervention cognitive dissonance	0.35	0.39	0.557	0.10
Immediate post-intervention positive dimension of explicit attitudes	0.26	0.58	0.615	0.12
Immediate post-intervention negative dimension of explicit attitudes	0.10	0.18	0.750	0.05
Immediate post-intervention positive dimension of implicit attitudes	0.01	< 0.01	0.981	<0.001
Immediate post-intervention negative dimension of implicit attitudes	0.26	0.02	0.611	0.11
Immediate post-intervention speeding behaviour	0.40	0.04	0.527	0.10

Table 5.3.2. Tests of attrition and condition for the one-month post-intervention subsample (continued)

Dependent Variable	*F*	MS	*p*	Cohen's *D*
Condition (0=control [42]; 1 = experimental [46])				
Pre-intervention positive dimension of explicit attitudes	1.44	2.26	0.233	0.26
Pre-intervention negative dimension of explicit attitudes	0.20	0.34	0.660	0.09
Pre-intervention speeding behaviour	2.93	2.36	0.091	0.37
Pre-intervention cognitive dissonance	0.90	0.60	0.346	0.21
Immediate post-intervention cognitive dissonance	N/A	N/A	N/A	N/A
Immediate post-intervention positive dimension of explicit attitudes	N/A	N/A	N/A	N/A
Immediate post-intervention negative dimension of explicit attitudes	N/A	N/A	N/A	N/A
Immediate post-intervention positive dimension of implicit attitudes	N/A	N/A	N/A	N/A
Immediate post-intervention negative dimension of implicit attitudes	N/A	N/A	N/A	N/A
Immediate post-intervention speeding behaviour	N/A	N/A	N/A	N/A

Table 5.3.2. Tests of attrition and randomisation for one-month post-intervention stage (continued)

Dependent Variable	*F*	MS	*p*	ηp^2
		Attrition x condition		
Pre-intervention positive dimension of explicit attitudes	.35	.50	0.557	0.002
Pre-intervention negative dimension of explicit attitudes	.50	.83	0.483	0.003
Pre-intervention speeding behaviour	.05	.05	0.819	<0.001
Pre-intervention cognitive dissonance	2.90	2.16	0.091	0.019
Immediate post-intervention cognitive dissonance	1.27	1.40	0.262	0.008
Immediate post-intervention positive dimension of explicit attitudes	3.42	7.44	0.066	0.022
Immediate post-intervention negative dimension of explicit attitudes	.08	.15	0.778	0.001
Immediate post-intervention positive dimension of implicit attitudes	1.76	.14	0.187	0.012
Immediate post-intervention negative dimension of implicit attitudes	.02	.001	0.901	<0.001
Immediate post-intervention speeding behaviour	1.16	.10	0.284	0.008

*Note: N/A: these measures were included in the analysis of condition only to permit the inclusion of the interactions with attrition. The differences between the conditions on the immediate post-intervention measures are not relevant to the issue of testing successful randomisation to condition because there are reasons to assume differences at immediate post-intervention (i.e., the intervention). The results relating to the differences between the conditions on the immediate post-intervention measures are therefore presented on sections 5.4.4, 5.4.5 and 5.4.6 when testing the hypotheses.

To test whether there were any differential effects of attrition between the conditions, a series of two-way ANOVAs was also conducted. The dependent variables were the pre-intervention measures of the positive (ANOVA 1) and negative (ANOVA 2) dimensions of explicit attitudes, self-reported speeding behaviour (ANOVA 3) and cognitive dissonance (ANOVA 4), and the immediate post-intervention measures of the positive (ANOVA 5) and negative (ANOVA 6) dimensions of explicit attitudes, the positive (ANOVA 7) and negative (ANOVA 8) dimensions of implicit attitudes, and objectively measured speeding behaviour on the driving simulator (ANOVA 9). The independent variables were condition (0 = control; 1 = experimental) and attrition (0 = dropped out of the study following the immediate post-intervention stage; 1 = completed the study). As shown in Table 5.3.2, there was no significant interactions between attrition and condition. Therefore, in addition to no major effects of attrition on the measures, it was concluded that there was no evidence for attrition having a differential effect on the conditions.

To gage whether randomisation to conditions was successful, a series of one-way ANOVAs was conducted to test whether there were any differences between the conditions on the pre-intervention measures. The dependent variables were the pre-intervention measures of the positive (ANOVA 1) and negative (ANOVA 2) dimensions of attitudes, self-reported speeding behaviour (ANOVA 3) and cognitive dissonance (ANOVA 4). The independent variable in each ANOVA was condition (0=control; 1 = experimental). It can be seen in Table 5.3.1 that when these analyses were run using the full sample of participants who completed the immediate-post-intervention measures (n = 153), there were no pre-intervention differences between the conditions. It can also be seen in Table 5.3.2 that there were no pre-intervention differences between the experimental and control conditions when these analyses were run on just the subsample of the participants who completed the one-month post-intervention measures (n = 88). Therefore, it was concluded that randomisation to conditions was successful (i.e., the conditions were equivalent prior to intervention, meaning that the post-intervention measures could be used to compare the experimental and control conditions in order to provide a meaningful test of the hypotheses and thus the effectiveness of the induced compliance intervention).

5.4.3. Descriptive statistics

The means and standard deviations for all measures are shown in Table 5.3.3 for the experimental and control conditions, separately. The means on the measures of cognitive dissonance were below the scale mid-point at both pre- and immediate post intervention, meaning that the participants, on average, reported low levels of cognitive dissonance across both these stages of the study. The means on the measure of the positive explicit attitude dimension were close to the scale mid-point at pre-, immediate-, and one-month post intervention, meaning that the participants on average rated the positive outcomes of speeding as moderately positive. The means on the measure of the negative explicit attitude dimension were, in general, more notably above the scale mid-point at pre-, immediate-, and one-month post intervention, meaning that the participants on average rated the negative outcomes of speeding as moderately-to-highly negative. The means on the measure of self-reported speeding were close to the scale mid-point at both pre- and one-month post intervention, meaning that the participants on average reported to speeding moderately often. At immediate post-intervention, the means on the objective measure of speeding behaviour from the driving simulator were about 0.40 (0.42 for the experimental condition and 0.41 for the control condition), meaning that the participants exceeded the speed limit for approximately 40% of the simulator drive.

It is also worth mentioning that, in line with expectations, the mean for the immediate post-intervention measure of cognitive dissonance was higher in the experimental condition than it was in the control condition, the mean for the measure of positive explicit attitudes, at both immediate post-intervention and one-month post-intervention, was lower in the experimental condition than it was in the control condition, and while the mean for immediate post-intervention speeding behaviour (on the driving simulator) was similar for both the experimental and control conditions, the mean for one-month post-intervention speeding behaviour (self-reported) was lower for the experimental condition than it was for the control condition (see Table 5.3.3).

Table 5.3.3. Descriptive statistics and one-way ANOVAs testing the intervention effects

Variables	*M (SD)*		ANOVA			
	Experimental condition	Control	*F*	*df*	*p*	Cohen's *d*
			Pre-intervention (*n* = 153)			
Cognitive dissonance	1.85 (0.92)	1.81 (0.81)	0.07	(1, 151)	0.792	0.05
Positive explicit attitudes	5.70 (1.16)	5.93 (1.23)	1.43	(1, 151)	0.233	0.19
Negative explicit attitudes	6.39 (1.30)	6.39 (1.28)	0.001	(1, 151)	0.972	<0.001
Speeding behaviour	5.29 (0.93)	5.59 (1.03)	3.42	(1, 151)	0.066	0.31
			Immediate post-intervention (*n* = 153)			
Cognitive dissonance	2.14 (1.20)	1.77 (0.87)	4.64	(1, 151)	0.033	0.35
Positive explicit attitudes	5.31 (1.54)	5.89 (1.42)	5.91	(1, 151)	0.016	0.39
Negative explicit attitudes	6.68 (1.30)	6.48 (1.38)	0.83	(1, 151)	0.384	0.15
Positive implicit attitudes	-.14 (0.29)	-.15 (0.27)	0.01	(1, 151)	0.932	0.04
Negative implicit attitudes	-.25 (0.30)	-.22 (0.26)	0.42	(1, 151)	0.519	0.11
Speeding behaviour	0.42 (0.29)	0.41 (0.30)	0.10	(1, 151)	0.753	0.03
			One-month post-intervention (n = 88)			
Positive explicit attitudes	5.21 (1.48)	5.86 (1.42)	4.34	(1, 86)	0.040	0.45
Negative explicit attitudes	6.43 (1.38)	6.37 (1.30)	0.04	(1, 86)	0.836	0.04
Speeding behaviour	4.63 (1.24)	5.51 (1.12)	12.24	(1, 86)	0.002	0.74

5.4.4 Effects of the induced compliance intervention on immediate post-intervention cognitive dissonance

A one-way ANOVA was conducted to test the hypothesis that the participants randomised to the experimental (induced compliance intervention) condition would report significantly greater levels of cognitive dissonance than would the participants randomised to the control condition immediately following intervention (hypothesis 1). The dependent variable was the immediate post-intervention measure of cognitive dissonance. The independent variable was condition (0 = control condition; 1 = experimental condition). Table 5.3.3 shows that the ANOVA revealed a significant effect of condition, with participants in the experimental condition reporting higher levels of immediate post-intervention cognitive dissonance than did the participants in the control condition (see Figure 5.2). Therefore, the null is rejected for hypothesis 1.

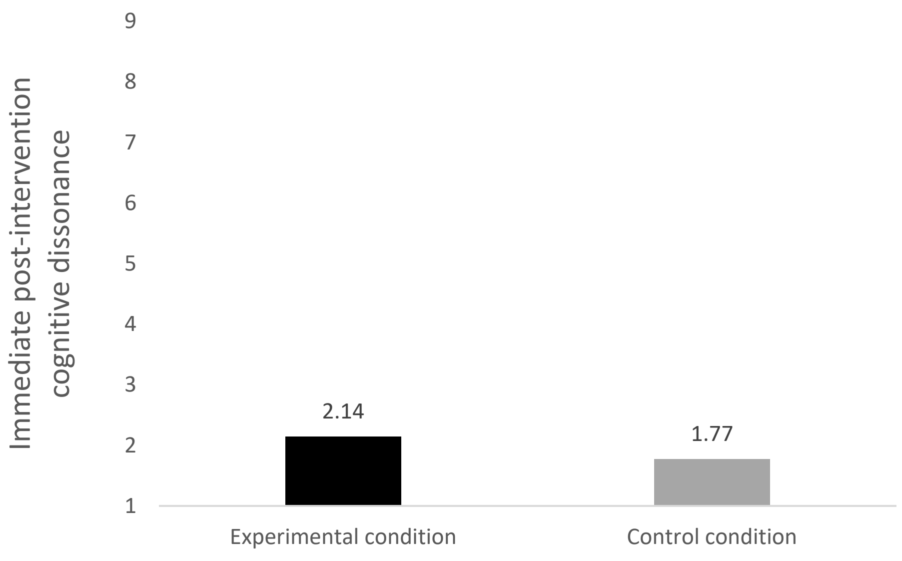

Figure 5.2: The effect of condition on immediate post-intervention cognitive dissonance

5.4.5 Effects of the induced compliance intervention on immediate post-intervention attitudes

A one-way ANOVA was conducted to test the hypothesis that the participants randomised to the experimental (induced compliance intervention) condition would report significantly less positive explicit attitudes than would the participants randomised to the control condition (hypothesis 2). The dependent variable in this analysis was the immediate post-intervention measure of the positive dimension of explicit attitudes, and the independent variable was condition (0 = control condition; 1 = experimental condition). The ANOVA revealed a significant effect of condition, with participants in the experimental condition reporting less positive explicit attitudes immediately post-intervention than did the participants in the control condition (see Table 5.3.3 and Figure 5.3). Therefore, the data provides evidence to reject the null for hypothesis 2.

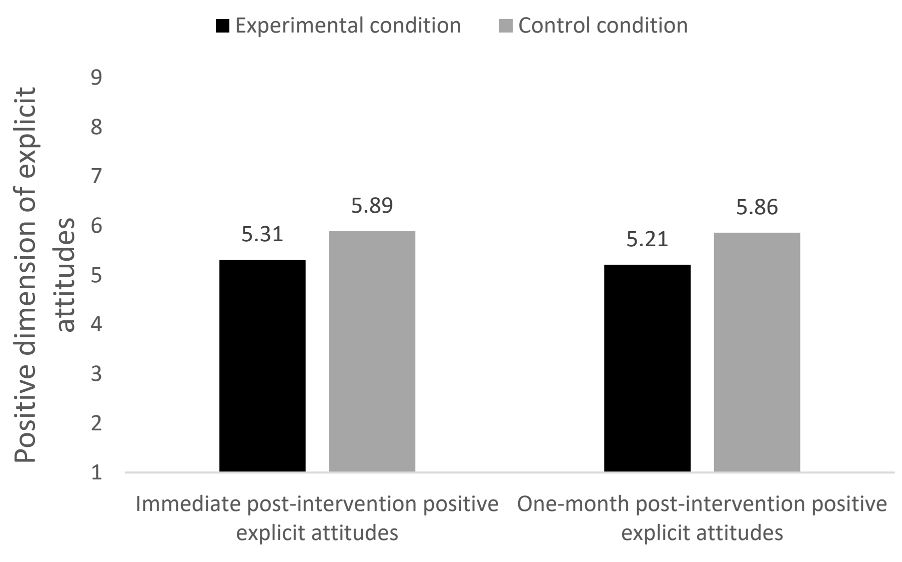

Figure 5.3: The effect of condition on immediate and one-month post-intervention positive explicit attitudes

Another one-way ANOVA was conducted to test the hypothesis that the participants randomised to the experimental (induced compliance intervention) condition would report significantly less positive implicit attitudes than would the participants randomised to the control condition immediately following intervention (hypothesis 3). In this analysis, the dependent variable was the immediate post-intervention measure of the positive dimension of implicit attitudes. Again, the independent variable was condition (0 = control condition; 1 = experimental condition). Table 5.3.3 shows that the ANOVA revealed no significant effect of condition, meaning the null is accepted for hypothesis 3.

In addition, two further one-way ANOVAs were conducted to test whether there was a difference between the experimental and control conditions on both the explicit and implicit measures of the negative attitude dimension at immediate post-intervention. Although no differences between the conditions on the negative dimensions of either explicit or implicit attitudes were hypothesised, on the basis that the induced compliance intervention was designed to target the positive attitude dimensions only (see section 5.3.3), these analyses were deemed important because it was possible that the intervention may have increased the negativity of the negative dimensions of attitudes (i.e., made the participants perceive speeding more negatively) independently of any effects that it had on the positive attitude dimensions. To more confidently conclude that the intervention successfully targeted the positive attitude dimensions, as intended, it was deemed important to rule out any effects of the intervention on the negative attitude dimension. The dependent variables in the analyses were the immediate post-intervention measures of the negative dimensions of explicit attitudes (AVOVA 1) and implicit attitudes

(ANOVA 2). The independent variable in both analyses was condition (0 = control condition; 1 = experimental condition). As shown in Table 5.3.3, these ANOVAs revealed no significant differences between the conditions.

5.4.6 Effects of the induced compliance intervention on immediate post-intervention behaviour

A one-way ANOVA was conducted to test hypothesis 4: that the participants randomised to the experimental condition would exceed the speed limit significantly less frequently than would the participants randomised to the control condition at immediate post-intervention. The dependent variable in this analysis was the immediate post-intervention measure of speeding behaviour from the driving simulator, and the independent variable was condition (0 = control condition; 1 = experimental condition). As indicated in Table 5.3.3., the ANOVA revealed no main effect of condition, meaning that hypothesis 4 was not supported. Consequently, the null is accepted for hypothesis 4.

5.4.7 Effects of the induced compliance intervention on one-month post-intervention attitudes

A one-way ANOVA was conducted to test hypothesis 5: that the participants randomised to the experimental condition would report significantly less positive attitudes than would the participants randomised to the control condition at one-month post-intervention. The dependent variable was the one-month post-intervention measure of the positive dimension of explicit attitudes. The independent variable was condition (0 = control condition; 1 = experimental condition). The ANOVA revealed a significant main effect of condition, with the participants in the experimental condition reporting less positive explicit attitudes at one-month post-intervention, on average, than the participants in the control condition (see Table 5.3.3 and Figure 5.3). Therefore, the data supports the rejection of the null for hypothesis 5.

As was the case at immediate post-intervention, it was possible that the induced compliance intervention may have increased the negativity of the negative dimension of attitudes at one-month post-intervention (i.e., made the participants perceive speeding more negatively) independently of any effects that it had on the positive dimension of attitudes. To rule out an intervention effect on the negative attitude dimension, another one-way ANOVA was conducted. The dependent variable was the one-month post-intervention measure of the negative dimension of explicit attitudes. The independent variable was condition (0 = control condition; 1 = experimental condition). The ANOVA revealed no significant main effect of condition (see Table 5.3.3).

5.4.8 Effects of the induced compliance intervention on one-month post-intervention behaviour

To test the hypothesis that the participants randomised to the experimental condition would exceed the speed limit significantly less frequently than would the participants randomised to the control condition at one-month post-intervention (hypothesis 6), a one-way ANOVA was conducted. The dependent variable was the one-month post-intervention measure of (self-reported) speeding behaviour. The independent variable was condition (0 = control condition; 1 = experimental condition). As shown in Table 5.3.3, the ANOVA revealed a significant effect of condition, with participants in the experimental condition reporting exceeding the speed limit significantly less frequently than the participants in the control condition (see Figure 5.4). Therefore, the null is rejected for hypothesis 6.

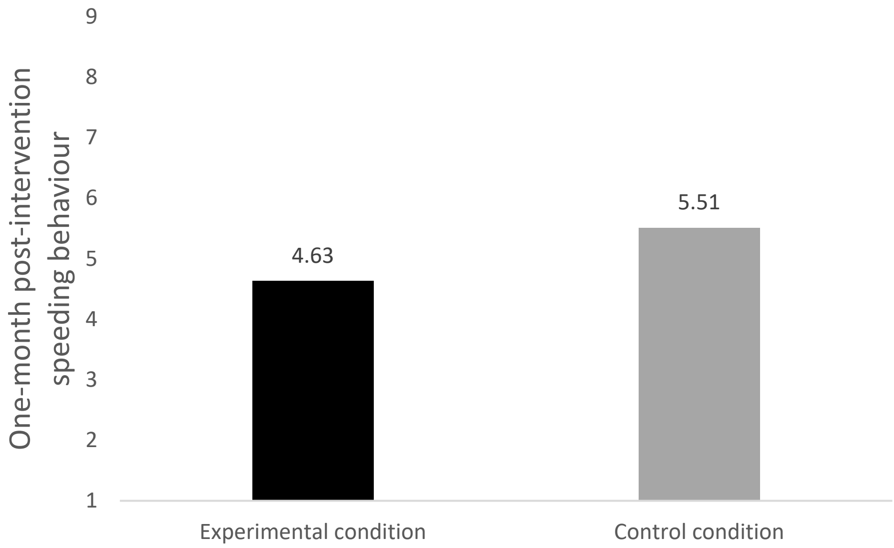

Figure 5.4: The effect of condition on one-month post-intervention speeding behaviour

5.4.9 Mediation effects

5.4.9.1 Mediation effects of cognitive dissonance on attitudes

Following Hayes (2009), two mediation analyses (mediation analyses 1 and 2) were conducted to test hypotheses 7 and 8: that cognitive dissonance at immediate post-intervention would mediate any effects of experimental versus control condition on both the immediate (hypothesis 7) and one-month post-intervention (hypothesis 8) attitude measures (i.e., any effect of the intervention on making attitudes towards speeding less positive would be due to it inducing cognitive dissonance). These two mediation analyses focused only on the explicit measures of the positive attitude dimension since the analyses reported in Table 5.3.3 showed that the intervention effects were limited to these measures; no intervention effects on the implicit attitude measures were found (see section 5.4.5) and, as expected, no intervention effects on the negative attitude dimensions were found (see section 5.4.5). The explicit measure of the positive attitude dimension at immediate post-intervention was the dependent variable in mediation analysis 1 and the explicit measure of the positive attitude dimension at one-month post-intervention was the dependent variable in mediation analysis 2. Condition (0 = control condition; 1 = experimental condition) was the independent variable in both mediation analyses and immediate post-intervention cognitive dissonance was the mediator.

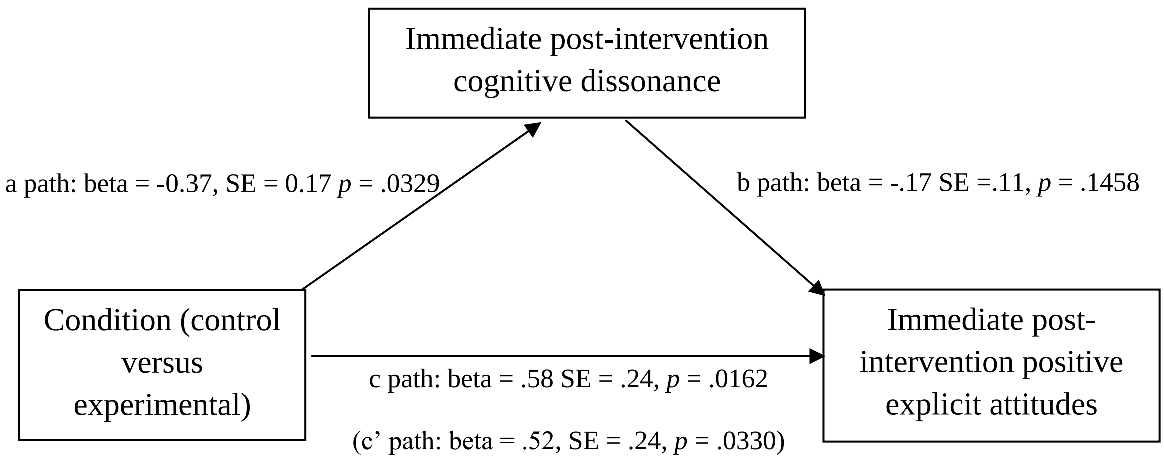

Figure 5.5. Immediate post-intervention positive explicit attitudes: the effect of condition on immediate post-intervention positive explicit attitudes by immediate post-intervention cognitive dissonance.

As can be seen in Figure 5.5, mediation analysis 1 showed that the effect of condition on immediate post-intervention cognitive dissonance was statistically significant (a path) as were both the total (c path) and direct (c' path) effects of condition on the explicit measure of the positive attitude dimension at immediate post-intervention. However, the effect of post-intervention cognitive dissonance on the explicit measure of the positive attitude dimension (b path) was not statistically significant. Additionally, Hayes (2009) bootstrapping procedure with 5000 random bootstrap samples showed that the indirect (mediation) effect of condition on the immediate post-intervention attitude measure through the immediate post-intervention measure of cognitive dissonance was not statistically significant at $p < .05$. This was because the 95% confidence interval around the indirect effect spanned zero (95% CI = -0.0210 to 0.1582). Thus, the null was accepted for hypothesis 7.

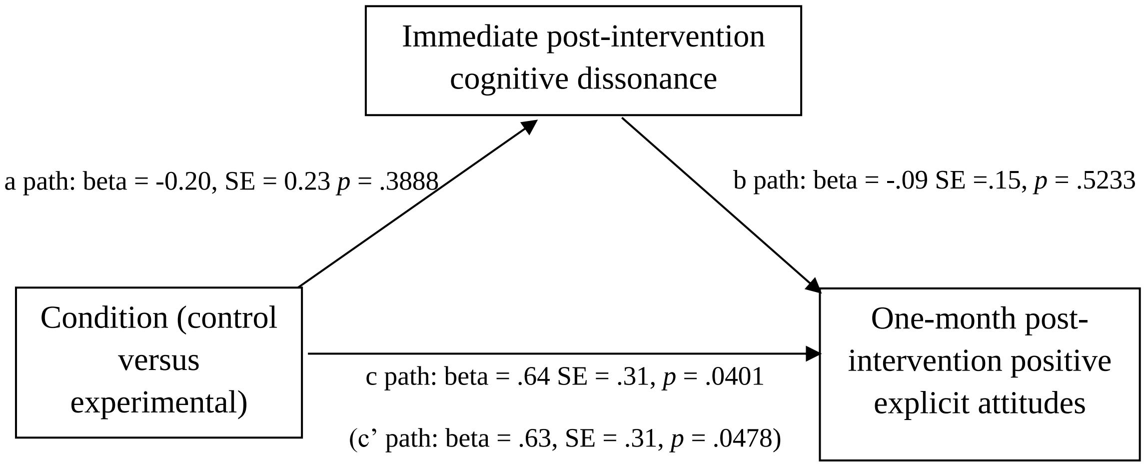

Figure 5.6. One-month post-intervention positive explicit attitudes: the effect of condition on one-month post-intervention positive explicit attitudes by immediate post-intervention cognitive dissonance.

As can be seen in Figure 5.6, mediation analysis 2 showed that the effect of condition on immediate post-intervention cognitive dissonance was not statistically significant (a path) nor was the effect of immediate post-intervention cognitive dissonance on the one-month post-intervention measure of positive explicit attitudes (b path). Although the total (c path) effect of condition on the one-month post-intervention measure of positive explicit attitudes was statistically significant, the direct (c' path) effect of condition on the one-month post-intervention measure of positive explicit attitudes was not. The Hayes (2009) bootstrapping procedure with 5000 random bootstrap samples additionally showed that the 95% confidence interval around the indirect (mediation) effect was 95% CI = -0.0555 to 0.1824. Since this spanned zero, the null was accepted for hypothesis 8.

5.4.9.2 Mediating effects of attitudes on behaviour

Two further mediation analyses (mediation analyses 3 and 4), both of which followed the Hayes (2009) technique, were conducted to test hypothesis 9 and 10: that any changes in attitudes following intervention would mediate any effects of condition on behaviour (i.e., any effect of the intervention on reduced speeding behaviour would be due to it having made attitudes more desirable from a road safety perspective). Similar to the above reported mediation analyses, these mediation analyses focused only on the explicit measures of the positive attitude dimension because the intervention was not found to have an effect on implicit attitudes or, as expected, the negative attitude dimension (see Table 5.3.3). These analyses also focused only on the one-month post-intervention measure of speeding behaviour since the intervention was found to only have an effect on that measure, not the immediate post-intervention behaviour measure. Thus, the measure of one-month post-intervention behaviour was the dependent variable in both mediation analysis 3 and mediation analysis 4. Condition (0 = control condition; 1 = experimental condition) was the independent variable in both mediation analyses. Immediate post-intervention positive explicit attitudes was the mediator in mediation analysis 3 and one-month post-intervention positive explicit attitude was the mediator in mediation analysis 4.

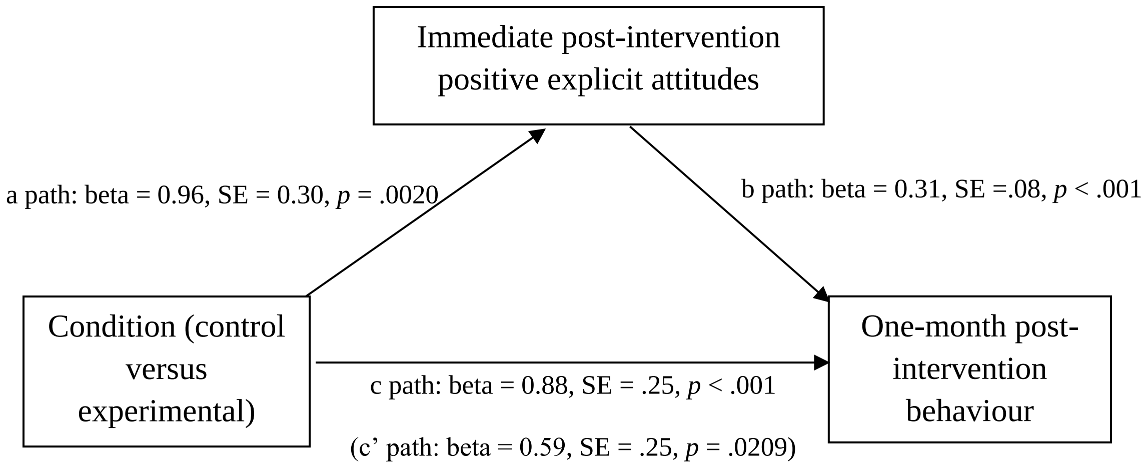

Figure 5.7. Mediation analysis 3: the effect of condition on one-month post-intervention speeding behaviour by immediate post-intervention positive explicit attitudes.

As can be seen in Figure 5.7, mediation analysis 3 showed that the effect of condition on immediate post-intervention positive explicit attitudes was statistically significant (a path) as was the effect of immediate post-intervention positive explicit attitudes on the one-month post-intervention measure of behaviour (b path). The total (c path) effect of condition on the one-month post-intervention measure of behaviour was statistically significant, as was the direct (c’ path) effect of condition on the one-month post-intervention measure of behaviour. The Hayes (2009) bootstrapping procedure with 5000 random bootstrap samples, additionally showed that the 95% confidence interval around the indirect (mediation) effect was 95% CI = 0.0792 to 0.5976. Since this did not span zero, the null was rejected for hypothesis 9.

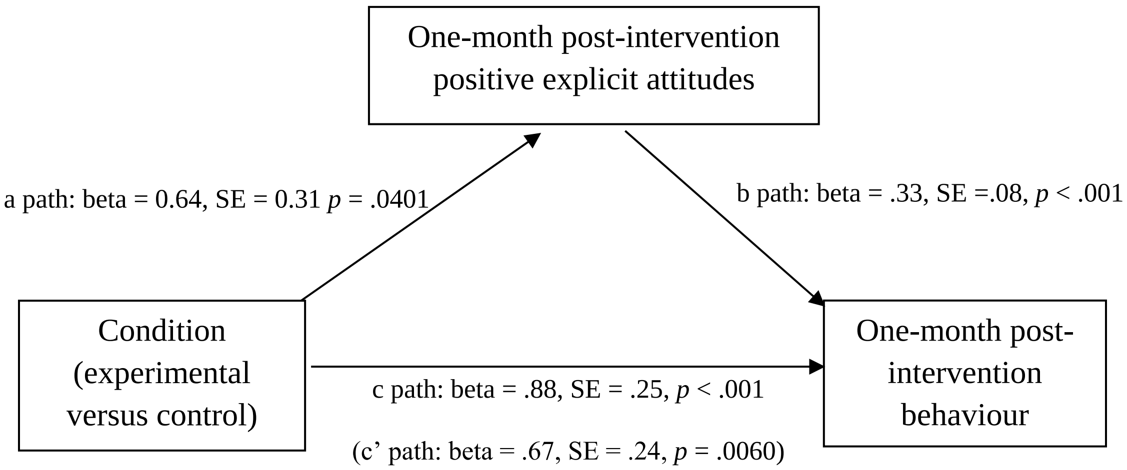

Figure 5.8. Mediation analysis 4: the effect of condition on one-month post-intervention speeding behaviour by one-month post-intervention positive explicit attitudes.

As can be seen in Figure 5.8, mediation analysis 4 showed that the effect of condition on one-month post-intervention positive explicit attitudes was statistically significant (a path) as was the effect of one-month post-intervention positive explicit attitudes on the one-month post-intervention measure of behaviour (b path). The total (c path) effect of condition on the one-month post-intervention measure of behaviour was statistically significant, as was the direct (c' path) effect of condition on the one-month post-intervention measure of behaviour. The Hayes (2009) bootstrapping procedure with 5000 random bootstrap samples, additionally, showed that the 95% confidence interval around the indirect (mediation) effect was 95% CI = 0.0071 to 0.4666. Since this did not span zero, this supports the rejection of the null for hypothesis 10.

5.5 Discussion

The primary aim of the research reported in this chapter was to develop and test an induced compliance intervention with a view to inducing cognitive dissonance and thereby change the positive dimensions of drivers' explicit and implicit attitudes towards speeding (on the basis of study 1 showing that the positive dimensions of both explicit and implicit attitudes were the sole predictors of speeding) and reduce their subsequent speeding behaviour. At immediate post-intervention, it was hypothesized that: the participants randomised to the experimental (induced compliance intervention) condition would report significantly greater levels of cognitive dissonance (hypothesis 1), have significantly less positive explicit (hypothesis 2) and implicit attitudes (hypothesis 3) and exceed the speed limit significantly less frequently (hypothesis 4) than would the participants randomised to the control condition. At one-month post-intervention, it was hypothesised that the participants randomised to the experimental condition would report significantly less positive attitudes (hypothesis 5) and exceed the speed limit significantly less frequently (hypothesis 6) than would the participants randomised to the control condition. Given that induced compliance interventions are theorised to generate cognitive dissonance, which in turn generates attitude-change, it was also hypothesised that the induction of cognitive dissonance at immediate post-intervention would mediate the effects of condition (experimental versus control) on both the immediate (hypothesis 7) and one-month post-intervention (hypothesis 8) attitude measures. Given that attitude-change is theorised to generate behaviour-change, it was hypothesised that any changes in attitudes following intervention would mediate any effects of the intervention on both the immediate (hypothesis 9) and one-month post-intervention (hypothesis 10) behaviour.

5.5.1 Immediate post-intervention effects of the induced compliance intervention

The null was rejected for hypothesis 1 as the participants randomised to the experimental condition reported significantly greater levels of cognitive dissonance than did the participants randomised to the control condition. The difference between the experimental and control participants in their levels of cognitive dissonance yielded an effect size of d = 0.35, which represents a small-to-moderate sized difference (Cohen, 1992). This finding, therefore, demonstrated that the induced compliance intervention was successful at inducing (self-reported) cognitive dissonance. This finding helps extend previous research on induced compliance interventions as cognitive dissonance is not measured in many previous studies and therefore direct tests of whether interventions induce cognitive dissonance have not been conducted to establish that induced compliance interventions can engender cognitive dissonance (Di Bello et al., 2018; Festinger & Carlsmith, 1959; Harmon-Jones et al., 2008; Joule & Martinie, 2008; Leippe & Eisenstadt, 1994; Stice et al., 2007).

The null was rejected for hypothesis 2 as the participants randomised to the experimental condition reported significantly less positive explicit attitudes towards exceeding the speed limit than did the participants randomised to the control condition. The difference between the experimental and control participants in the positive dimensions of their explicit attitudes yielded an effect size of d = 0.39, which represents a small-to-moderate sized improvement in the positive dimension of explicit attitudes (Cohen, 1992). In the context of previous research on attitude interventions, this effect size is impressive because, as discussed in chapter 2, previous research shows that interventions typically have no significant effect on attitudes within the context of road safety (e.g., Brijs et al., 2014; Elliott & Armitage, 2009; Glendon et al., 2014; Goldenbeld et al., 2008; Lang et al., 2010; Parker et al., 1996; Poulter & McKenna, 2010), and this is also the case for many other health behaviours (e.g., Hardeman et al., 2002). The finding that the induced compliance intervention successfully changed drivers' attitudes, immediately following intervention, is in line with previous research in other contexts (e.g., Festinger & Carlsmith, 1959; Harmon-Jones et al., 2008; Joule & Martinie, 2008; Leippe & Eisenstadt, 1994; see chapter 3). However, this is the first time that an induced compliance intervention has been developed in the context of driving, with a view to changing a behaviour such as speeding, which is known to be highly habitual (e.g., Ouellette & Wood, 1998) and therefore difficult to modify. The present findings also extend previous research on cognitive dissonance interventions more generally because they show that the induced compliance intervention changed only the positive dimension of explicit attitudes, not the negative dimension. This study has therefore demonstrated, for the first time, that induced compliance interventions can be developed to independently, and successfully, target the key dimension of attitude that predicts risky health behaviours (Elliott, Brewster, et al., 2015), including speeding (Conner et al., 2002; Elliott, Brewster, et al., 2015; McCartan & Elliott, 2018; McCartan et al., 2018).

The null was, however, rejected for hypothesis 3 as the participants randomised to the experimental condition did not have significantly less positive implicit attitudes than did the participants randomised to the control condition. A possible reason why implicit attitudes did not change following the induced compliance intervention could be that the association between attitudes and behaviour was not coded in memory to a great enough extent to be able to change implicit attitudes. Further research testing whether increased dosage of induced compliance interventions can successfully alter implicit attitudes and potentially enhance their capacity to change behaviour would be valuable. Additionally, augmenting the present intervention with established techniques for promoting implicit associations (e.g., evaluative conditioning tasks; Olson & Fazio, 2006) would be a worthwhile endeavour. It is worth mentioning at this stage, however, that the findings of study 1 (chapter 4) showed that explicit attitudes were stronger predictors of speeding than were implicit attitudes. From an applied perspective there may be value in findings ways to alter implicit attitudes towards speeding but it should not be forgotten that the present induced compliance intervention changed the types of attitudes that are likely to be most instrumental in dictating this behaviour (i.e., explicit attitudes).

The null was also accepted for hypothesis 4 as the participants randomised to the experimental condition did not exceed the speed limit significantly less frequently than did the participants randomised to the control condition. Although a small number of previous studies have demonstrated that induced compliance interventions can change post-intervention behaviour (see chapter 3), those studies have typically measured behaviour over a longer time period. For instance, Di Bello et al. (2018) measured alcohol consumption and Stice et al. (2007) measured eating disorder related behaviour over 1 month following intervention. It is possible that behaviour-change in previous studies was also not immediate, and a gestation period was needed before the participants' attitude-change translated into behaviour-change (discussed further in the next subsection).

5.5.2 One-month post-intervention effects of the induced compliance intervention

The data provided evidence to support the rejection of the null for hypothesis 5 as the participants randomised to the experimental condition reported significantly less positive explicit attitudes than did the participants randomised to the control condition. The difference between the experimental and control participants in their positive explicit attitudes yielded an effect size of d = 0.45, which represents a small-moderate sized difference in positive explicit attitudes (Cohen, 1992). This finding, therefore, demonstrated that the induced compliance intervention was not only successful at changing the positive dimension of the participants' explicit attitudes immediately following intervention but that this desirable change in attitude maintained one-month later. This finding is important because the previous research reviewed in chapter 2 showed that educational interventions generate, at best, small-sized changes in attitudes immediately following intervention (e.g., Cuenen et al., 2016). Studies testing longer-term effects (e.g., 1 month or more) have not found any changes in attitudes following the delivery of an educational intervention (Elliott & Armitage, 2009; Poulter & McKenna, 2010: study 1). This study therefore provides encouraging evidence to suggest that the induced compliance intervention developed in this study is an improvement upon existing attitude-change interventions currently used in the field (see chapter 1).

The data also provided support to reject the null for hypothesis 6 as the participants randomised to the experimental condition also reported exceeding the speed limit significantly less frequently than the participants randomised to the control condition at one-month post-intervention. The difference between the experimental and control participants in their speeding behaviour yielded an effect size of $d = 0.74$. This represents a moderate-to-large sized effect of the present induced compliance intervention on one-month post-intervention speeding behaviour (Cohen, 1992). However, as discussed above, there was no such intervention effect immediately following intervention. An explanation for the current findings is that speeding behaviour was measured objectively, using a driving simulator, at the immediate post-intervention stage of the study, whereas it was measured subjectively, using a self-report questionnaire, at the one-month post-intervention stage. This raises the possibility that the significant intervention effect that was observed for the one-month post-intervention behaviour measure was attributable to self-reporting biases. On the other hand, no significant intervention effect may have been observed for the immediate post-intervention behaviour measure because it may have been less susceptible to self-reporting biases.

Another explanation for the findings, however, is that the participants needed time to reflect on their newly changed attitudes following the intervention before being able to convert them into behaviour-change. As mentioned above, this is consistent with previous research which has also shown that behaviour-change has been observed in the weeks following an induced compliance intervention. This contention is also supported by several lines of argument. First, drivers need to select their travelling speed on a moment-by-moment basis for the duration of every single drive. This high level of repetition of speed selection can lead to frequent occurrences of speeding behaviour and behavioural frequency promotes habituation (see Ouellette & Wood, 1998). This means that speeding can become a hard behaviour to change and drivers may need time to ‘break the habit’ of speeding once attitude-change has occurred. Second, the data analyses conducted in this study revealed that the differences between the experimental and control participants at one-month post-intervention were specific to the self-reported measures of behaviour and the positive dimension of explicit attitudes, consistent with the hypotheses. There was no difference on the measure of the negative dimension of explicit attitudes, which was also self-reported and therefore helps to rule out a potential self-reporting bias as an explanation for the pattern of findings. Although it was not feasible in this programme of research to measure speeding objectively on the driving simulator on more than one occasion, and it was decided that the immediate post-intervention phase was the best use of the objective measure in terms of reducing attrition (see method section), future research might usefully measure speeding objectively one-month post-intervention, or longer.

5.5.3 Mediating effects of cognitive dissonance and attitudes

The null was accepted for hypotheses 7 and 8 as although the participants randomised to the experimental condition reported significantly greater levels of cognitive dissonance than did the participants randomised to the control condition, cognitive dissonance was not found to mediate the effect of the intervention (condition) on either the immediate or one-month post-intervention attitude measures. No evidence was found, therefore, for the theoretical proposition that cognitive dissonance generates attitude-change (Festinger, 1957). That raises the question as to why the induced compliance intervention engendered a change in attitudes. One explanation can be found in Bem (1967; 1972)’s self-perception theory, which maintains that people determine their attitudes and preferences by interpreting the meaning of their own behaviour. This theory suggests that people do not have insight into their own attitudes and so determine their attitudes based on how they have behaved. This leads their attitudes and behaviour to be in line with one another, without the need for any drive state, as proposed by cognitive dissonance theory. In this study, the induced compliance intervention required the participants to argue, contrary to their existing attitudes at the time, that speeding was not a positive behaviour. They did this by generating arguments countering their existing reasons for viewing speeding as a positive behaviour. In doing this, the participants may well have experienced cognitive dissonance. Equally, however, their behaviour may have made them perceive through the cognitive process of self-perception that their attitudes were different (less positive) than they were previously and that self-perception process may have been the explanation for the observed shifts in attitudes rather than the observed cognitive dissonance.

Alternatively, it is reasonable to assume that the cognitive process of persuasion (e.g., Petty & Cacioppo, 1979) may have generated the observed attitude-change. Although the evidence for persuasive messages generating attitude-change is not very strong (see chapters 1 and 2), it is likely that they have the capacity to alter attitudes when participants generate the messages themselves. It is known from the literature on persuasion (e.g., Hovland, Janis, & Kelly, 1953) that attitude-change is more likely when the source of a persuasive message is credible and the audience can comprehend and accept the message. In the present study, the participants were effectively both the source of the messages that were developed and the audience. To avoid a threat to their own self-integrity (e.g., Steele, 1988) they would be unlikely to view themselves as non-credible sources. Similarly, since the participants developed their own messages they would be likely to comprehend and perhaps accept them to a greater extent than they would a message delivered to them (e.g., through a passive intervention such as a road safety leaflet).

It is also possible that cognitive dissonance was responsible for the changes in attitudes that were observed in this study but the self-reported measure of cognitive dissonance that was used was not sufficient for detecting the effect. Cognitive dissonance was measured using the dissonance thermometer. Although this is an established tool, and an intervention effect on the measure of cognitive dissonance that it produces was found in this study, previous experimental studies have often failed to find that effect (e.g., Chait, 2010; Simmons et al., 2004). It is possible therefore that the measure is not a particularly sensitive one for detecting the magnitude of cognitive dissonance induction taking place when an induced compliance intervention, such as the one developed in this study, is delivered. Physiological measures of arousal (e.g., galvanic skin responses) can be used to indicate emotional reactivity (e.g., Croyle & Cooper, 1983; Elkin & Leippe, 1986; Losch & Cacioppo, 1990) and may therefore provide more sensitive measures of cognitive dissonance than self-reports. Such measures may indicate a greater magnitude of dissonance induction, which has greater scope to be found to mediate attitude-change in experimental research such as this. Future research is, therefore, needed to determine the theoretical mechanisms underpinning attitude-change following the delivery of an induced compliance intervention. Further research might usefully test self-perception, persuasion and physiologically measured cognitive dissonance as mediators of attitude-change.

The final two hypotheses concerned the potential causal relationship that is proposed by the attitude-behaviour models reviewed in chapter 2, namely that attitude-change generates behaviour-change. Hypothesis 9 (that any difference between the experimental and control conditions in speeding behaviour immediately following intervention would be mediated by attitudes) could not be tested because the intervention was not found to have an effect on the immediate post-intervention behaviour measure (i.e., any mediation effect would be conceptually uninterpretable). However, as the intervention was found to have an effect on the one-month post-intervention behaviour measure, a mediation analysis was conducted to test hypothesis 10 (that any difference between the experimental and control conditions in speeding behaviour one-month post- intervention would be mediated by attitudes). The null was rejected for hypothesis 10 as both the immediate and one-month post-intervention measure of the positive dimension of explicit attitudes were found to mediate the relationship between condition and one-month post-intervention behaviour. These findings are consistent with the idea that the behaviour-change observed in this study (as measured at one-month post-intervention) was attributable to the observed and sustained changes in attitudes (as measured at both immediate and one-month post-intervention), consistent with the causal direction between attitudes and behaviour (i.e., attitudes → behaviour) that is proposed by many models in the literature (see chapter 2). The findings are also in line with the small number of induced compliance intervention studies in other domains in which researchers have tested whether attitudes mediate behaviour-change (e.g., Di Bello et al., 2018).

5.5.4 Methodological considerations

Although this study provides evidence that an induced compliance intervention can be used to modify drivers attitudes towards speeding and subsequent speeding behaviour, the findings need to be interpreted in light of several methodological considerations over and above those already mentioned in this discussion (i.e., the measurement of behaviour and cognitive dissonance). First, the power analysis reported in section 5.4.1 indicated that the required sample size for this study was n = 102. While the pre- and immediate post-intervention measures were collected from a greater number of participants than this (n = 153), the one-month post-intervention measures were collected from fewer participants (n = 88). The potential risk therefore is that the null hypotheses relating to the post-intervention measures were incorrectly accepted (i.e., there was a potential risk of making a type 2 error). This was not an issue, however, because there were significant differences between the experimental and control conditions on the one-month post-intervention measures of attitudes (positive dimension) and behaviour, as hypothesised. Therefore, the null hypotheses relating to the post-intervention measures were rejected (i.e., there could be no type 2 error) and no additional data collection was required (see Norton & Strube, 2001).

A second methodological consideration is that there was a significant difference on the pre-intervention measure of the positive dimension of explicit attitudes between those who completed the immediate post-intervention measures and those who dropped out of the study after pre-intervention. This had the potential to bias the results from the analyses of the post-intervention measures, making it more likely that significant intervention effects would be found, if the drop-outs were less safety conscious (i.e., had more positive attitudes towards speeding prior to intervention) than the study completers and therefore less motivated to be safer following the intervention. However, the participants who remained in the study reported more positive attitudes towards speeding than did those who dropped out. The participants who remained in the study, and were used in the data analyses, were therefore less safety conscious to begin with and yet a significant improvement in attitudes and behaviour was still found.

A third methodological consideration is that the effects of the induced compliance intervention were tested over a one-month period. This raises the question of whether the intervention would have longer lasting effects. Although further research testing the potential longer-term effects of the intervention would be valuable, previous research has shown that changes in behaviour that have been observed after one month tend to persist (e.g., Armitage, 2005). In addition, studies of cognitive dissonance interventions have reported sustained effects 3 years post-intervention (e.g., Stice et al, 2008), which suggests that the effects of these interventions may be long lasting (e.g., 3 years).

A fourth methodological consideration is that the sample comprised largely of students. This is a potential problem as samples comprising mainly university students are often criticised on the presumption that students may be more likely to be compliant with task demands (e.g., Jackson et al., 2005). This potentially increases the risk that studies using predominantly student samples will be biased towards producing significant results (e.g., intervention effects). However, the findings are still held with confidence because this was a randomised controlled study, and the participants in both the experimental and control condition received an intervention, so any susceptibility to experimenter demand would have been equalised across the conditions. Furthermore, previous research has shown that the findings from intervention studies are typically the same regardless of whether student or non-student samples are used (e.g., Gollwitzer & Sheeran, 2006a).

5.5.5 Conclusions

In conclusion, the research reported in this chapter provided evidence that induced compliance interventions can be developed in order to change drivers' attitudes towards speeding and their subsequent speeding behaviour. Although behaviour-change was not found immediately post-intervention and no evidence was found to suggest that the intervention altered attitudes through the theoretical process of cognitive dissonance, it was encouraging that the intervention was found to generate attitude-change immediately post-intervention and both attitude- and behaviour-change one-month later, suggesting that it has potential to generate long-lasting improvement in road safety. Additionally, attitude change, both immediately and one-month post-intervention, was found to mediate the observed behaviour-change, which is in line with the theoretical proposition of the models of attitudes and behaviour reviewed in chapter 2. Of course, the intervention that was developed and tested in this study was designed to reduce speeding by targeting drivers with positive (unsafe) attitudes towards this behaviour and while there are many drivers who have these attitudes there are also many drivers who speed in spite of pre-existing negative (safe) attitudes, as reviewed in chapter 2. The study reported in the next chapter was therefore designed to address this issue.

Chapter 6: Study 3: Using a hypocrisy induction intervention to reduce drivers' speeding behaviour[9]

6.1 Abstract

The aim of this study was to test a hypocrisy induction intervention in a sample of drivers with anti-speeding attitudes. Specifically, the aim of this study was to test a hypocrisy induction intervention that was designed to induce cognitive dissonance and help drivers convert their attitudes towards speeding into safe speeding behaviour. The participants (n=164 drivers with anti-speeding attitudes) completed pre-intervention measures of explicit bi-dimensional attitudes, self-reported speeding behaviour, and cognitive dissonance. They were then randomised to either an experimental condition or to one of two control conditions. The participants in the experimental condition (n=54) were asked to complete the hypocrisy induction intervention, and the participants randomised to the control conditions were asked to complete one of two control interventions. All participants then completed immediate post-intervention measures of cognitive dissonance and explicit bi-dimensional attitudes. They also drove on a driving simulator to obtain an immediate post-intervention measure of speeding behaviour. One month later, n=112

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[9] The research reported in this chapter has been presented at: the 29th International Conference on Traffic and Transport Psychology, Montreal, Canada (26-30 June, 2018). This has resulted in the following publication: McCartan, R., & Elliott, M. A. (2018). Using cognitive dissonance inducing interventions to change drivers' speeding behaviour. *Proceedings of the 29th International Congress of Applied Psychology*, Montreal, Canada.

participants completed one month post-intervention measures of explicit attitudes and self-reported speeding behaviour. As expected, the intervention was found to generate reductions in speeding behaviour compared to standard road safety interventions, at both immediate post-intervention (objective behaviour) and one-month post-intervention (self-reported behaviour). However, the intervention was not found to generate changes in cognitive dissonance.

6.2 Introduction

The research reported in the previous chapter provided promising evidence that an induced compliance intervention can bring about reductions in speeding behaviour through attitude-change. However, as discussed in chapter 2, whilst a substantial proportion of drivers who exceed the speed limit have undesirable attitudes (e.g. “speeding is fun or beneficial”) that need changing from a road safety perspective, there is also a substantial proportion of drivers who already have generally desirable attitudes towards speeding (e.g., “speeding is harmful”) but nevertheless exceed the speed limit in spite of them. An attitude-change (e.g., induced compliance) intervention is therefore unlikely to reduce the extent to which these drivers exceed the speed limit. Instead, these drivers need an intervention to help convert their generally desirable attitudes into behaviour (reductions in speeding). The research reported in this chapter therefore focused on testing a hypocrisy induction intervention that was designed to reduce drivers’ speeding behaviour through the induction of cognitive dissonance.

Recall in chapter 3 that the hypocrisy induction paradigm (Aronson et al., 1991) provides an intervention technique that can be used to convert desirable (e.g., anti-speeding) attitudes into behaviour. Participants are asked to complete two sub-tasks. The first task was an attitude-saliency sub-task, which is designed to make individuals aware of their generally desirable attitudes (e.g., drivers who currently speed and who hold negative [i.e., safe] attitudes towards speeding could be asked to state their desirable attitudes or perform a behaviour that makes their desirable attitude salient [e.g., support a local road safety campaign]). The second task was a mindfulness sub-task, which is designed to make individuals aware of the discrepancies between their attitudes and their recent behaviour (e.g., the afore-mentioned drivers could be asked to recall past instances when they have exceeded the speed limit and therefore have not behaved in line with their negative attitudes towards this behaviour). This is theorised to result in cognitive dissonance (Festinger, 1957), which individuals are motivated to reduce (see chapter 3). To reduce cognitive dissonance, individuals can either change their attitudes (e.g., form positive [unsafe] attitudes towards speeding) so that they fall in line with their recent behaviour or they can change their subsequent behaviour (e.g., reduce speeding) so that it falls in line with their existing attitudes. As discussed in chapter 3, it is held that behaviour-change is the primary strategy that people will use to reduce cognitive dissonance following a hypocrisy induction intervention. This is because changing socially desirable attitudes that are based upon well-accepted normative standards (e.g., societal norms that are against speeding) poses a threat to self-integrity (i.e., viewing oneself as a good, moral person, who acts in line with accepted social norms) whereas changing behaviour does not (Stone et al., 1997). Hypocrisy induction interventions, therefore, have the potential to help drivers with desirable attitudes towards speeding convert those attitudes into reductions in subsequent speeding behaviour.

As also discussed in chapter 3, and similar to the rationale for study 2 (chapter 5), interventions based on cognitive dissonance (e.g., hypocrisy induction interventions) are likely to be effective at reducing speeding because they address the key limitations with previous road safety educational initiatives, which were raised in chapter 2. More specifically, they are grounded in theoretical principles of behaviour-change (i.e., cognitive dissonance theory) rather than intuition. They are also held to change behaviour through direct experience (i.e., unpleasant feelings of cognitive dissonance that result from participants reflecting on their own past behavioural transgressions) rather than indirect experience (e.g., passively learning from second-hand sources that speeding can result in increased traffic crash-risk or getting caught by the police). Furthermore, while the research reviewed in chapter 3 showed that hypocrisy induction interventions have previously been found to be successful at changing behaviour (e.g., Dickerson et al., 1992; Fried, 1998; Fried & Aronson, 1995; Stone et al., 1994) only one study has, to date, focused on driver behaviour. As discussed in chapter 3, Fointiat (2004) found that a greater proportion of his experimental participants, who received a hypocrisy induction intervention that focused on speeding, subsequently reported that they would be willing to have a tachometer installed in their car than did his control participants (38% compared with 11%, respectively). Nevertheless, a major limitation of Fointiat (2004)'s study, as discussed in chapter 3, was that a measure of behavioural willingness was used as the primary outcome measure and measures of behavioural willingness account for about half of the variance in subsequent speeding behaviour only (e.g., Elliott et al., 2017). Although this is regarded as a 'large' proportion of variance in the social sciences (Cohen, 1992), it still means that many drivers who are unwilling to speed go on to exceed the speed limit (or vice versa). Given this substantial imperfection in the willingness-behaviour relationship, it is important for researchers to use measures of behaviour when testing interventions. In addition, the measure of behavioural willingness in Fointiat (2004) was operationalised with respect to having a recording tachometer installed in the participants' cars, not speeding. This means that, to date, there have been no direct tests of whether hypocrisy induction interventions can generate reductions in speeding.

There are also several potential limitations with the previous hypocrisy induction studies from non-driving domains (see chapter 3), which were addressed in this study. First, hypocrisy induction interventions have typically been tested in previous research using samples that have not been screened to ensure that the participants all hold desirable attitudes and engage in the problem behaviour in the first place. This includes Fointiat (2004)'s study focusing on speeding and it is problematic because hypocrisy induction interventions are designed to change problem behaviours by helping individuals convert their desirable attitudes into action. The effectiveness of hypocrisy induction interventions might therefore have been underestimated in previous studies because the samples used to test the interventions would have been likely to comprise many individuals who already refrained from performing the problem behaviour (i.e., individuals for whom the intervention was not needed) or did not possess the required (desirable) attitudes that could be converted into behaviour-change (i.e., individuals for whom an attitude-conversion intervention, such as a hypocrisy induction intervention, was not appropriate). As in the study reported in the previous chapter, therefore, the participants in this study were screened. In this study, they were screened in order to ensure that the hypocrisy induction intervention was tested using a sample of drivers who, prior to the intervention, reported that they exceeded the speed limit regularly (i.e., behaviour-change required) and that they had desirable attitudes (i.e., attitude-conversion intervention appropriate).

Second, the outcome measures used to test the effectiveness of the hypocrisy induction interventions in many previous studies have been self-reported. As discussed previously, self-report measures of behaviour are often criticised for being potentially vulnerable to cognitive biases such as primacy and recency effects (Krosnick & Presser, 2010; Murdock, 1962), affective biases such as mood congruent memory effects (Mayer et al., 1995) and self-presentation biases such as self-deception (Gur & Sackeim, 1979) and impression management (Paulhus & Reid, 1991). Therefore, as was the case in the previous studies reported in this thesis, the study reported in this chapter employed an objective measure of speeding behaviour, in addition to a self-reported measure, to test the effectiveness of the hypocrisy induction intervention.

Finally, researchers have typically not included measures of cognitive dissonance in many previous studies of hypocrisy induction interventions (Dickerson et al., 1992; Fointiat, 2004; Fried, 1998: study 1; Fried & Aronson, 1995; Stone et al., 1994). These researchers have not therefore explicitly tested whether hypocrisy induction interventions have generated cognitive dissonance or if the behaviour-change that followed the hypocrisy induction interventions could be attributed to cognitive dissonance. Instead, these researchers have only assumed that cognitive dissonance has been engendered on the basis of behaviour-change. There is, therefore, a need for research in which cognitive dissonance is measured in order to provide an explicit test of whether any behaviour-change following a hypocrisy induction interventions is attributable to cognitive dissonance, in line with theory (Festinger, 1957). This is particularly important given the findings of the previous study reported in this thesis in which a cognitive dissonance intervention, based on induced compliance, was found to engender changes in attitudes and behaviour that were not found to be attributable to cognitive dissonance. The study reported in this chapter, therefore, measured cognitive dissonance in addition to attitudes and speeding behaviour to test whether reductions in drivers' speeding behaviour following a hypocrisy induction intervention could be attributed to cognitive dissonance, in line with theory (Festinger, 1957).

To summarise, the primary aim of the research reported in this chapter was to test a hypocrisy induction intervention that was designed to induce cognitive dissonance and thereby encourage drivers to reduce their speeding behaviour in line with their generally desirable attitudes towards speeding. At immediate post-intervention, it was hypothesized that the participants randomised to the experimental (hypocrisy induction intervention) condition would report significantly greater levels of cognitive dissonance (hypothesis 1) and exceed the speed limit significantly less frequently (hypothesis 2) than would the control participants. At one-month post-intervention, it was expected that the difference in speeding behaviour between the participants randomised to the experimental and control conditions would be maintained (hypothesis 3). No differences between the conditions were expected in attitudes towards speeding because hypocrisy induction interventions are held to change behaviour through the process of attitude-conversion rather than attitude-change. However, it was hypothesised that the measure of cognitive dissonance would mediate any effects of the intervention on both the immediate post-intervention (hypothesis 4) and one-month post-intervention (hypothesis 5) behaviour measures (i.e., any behaviour-change following intervention would be attributable to cognitive dissonance, in line with theory).

6.3 Method

6.3.1 Participants

N = 164 participants completed both the pre- and immediate-post intervention stages of the study (*n* = 54 in the experimental [intervention] condition; *n* = 56 in the first of two control conditions; *n* = 54 in control condition 2). *N* = 112 participants completed the one-month post-intervention stage of the study (*n* = 38 in the experimental condition; *n* = 38 in control condition 1 and *n* = 36 in control condition 2). To maximise the *n* in the subsequent analyses, the full sample (i.e., the *N* = 164 participants who completed the pre- and immediate post-intervention stages of the study) was used to test hypotheses 1, 2 and 4 (i.e., the hypotheses relating to the immediate post-intervention measures). The subsample (i.e., the *N*= 112 participants who also completed the one-month post-intervention stage) was used to test hypotheses 3 and 5 (i.e., the hypotheses relating to the one-month post-intervention measures). The mean age of the full sample was 26.24 (*SD*=10.21; range= 17-58) and 28.00 % was male (*n*= 46). The mean weekly mileage was 86.03 (*SD*= 81.39; range= 3-400) and the mean number of years that the participants been licenced to drive was 7.05 (*SD*= 9.27; range= 0.08-39.42). The mean age of the subsample was 26.50 (*SD*=10.24; range= 17-58) and 25.9% was male (*n*= 29). The mean weekly mileage was 79.35 (*SD*= 70.14 range= 3-400) and the mean number of years that the participants had held a full driving licence was 7.28 (*SD*= 9.31; range= 0.25-39.42).

A series of one-way ANOVAs showed that there were no differences in age, F (1, 162) = 24.28, p = .631, weekly mileage, F (1, 162) = 15772.74, p = .123, or the number of years licenced to drive, F (1 162) = 18.35, p = .645, between the participants who completed the pre- and immediate post-intervention stages of the study only (n = 52) and those who completed all stages (n = 112). A Chi-Square showed that there was no difference between the two groups on sex, χ^2 (1) = .81, p = .367. Attrition analyses, reported below (section 6.4.2) also showed that there were no differences between these two groups on the key outcome measures of attitudes and behaviour. There was therefore no evidence that systematic biases were introduced by the approach used to maximise the N in the analyses.

6.3.2 Design and Procedure

Ethical approval for conducting this study was awarded by the University's School of Psychological Sciences and Health ethical committee. Data collection for this study was carried out by myself and 2 undergraduate and 2 postgraduate students at the University, under my supervision. As discussed in chapter 5, in order to make the recruitment process more effective, this study was conducted at the same time as study 2. A randomised control design was used. As was the case in study 2 (chapter 5), the participants were recruited through advertisements placed on notice boards around the campus of a large university in the west of Scotland and online posts including advertisements on social networking sites (e.g., Facebook and Twitter) and the virtual learning environment of the university. The advertisements stated that the study was a general-purpose investigation into driver behaviour and attitudes. As was the case in study 2, to avoid a potential bias in the results (i.e., receiving a behaviour change intervention, such as cognitive dissonance inducing interventions, may in itself alter participants' behaviour), participants were not informed the study was about cognitive dissonance interventions. Instead, the advertisements stated that the study was a general-purpose investigation into driver behaviour and attitudes. Embedded within the advertisement was a web-link to an online questionnaire, which contained the participant information sheet (see Appendix D), which again explained that the study was a general purpose investigation into drivers' attitudes towards speeding. The online questionnaire was used to measure demographic information (e.g., age, gender, weekly mileage, number of years licenced to drive), and pre-intervention (self-reported) speeding behaviour and explicit attitudes towards speeding. The measure of speeding behaviour was the same 20-item scale used in study 2, which measured how often the participants exceeded the speed limit in 20 specific situations (see Table 6.2). Both the positive and negative dimensions of explicit attitudes were measured using the standard unipolar, bi-dimensional scales that were employed in studies 1 and 2. A standard bi-polar unidimensional measure of attitudes was also included to assess how negative to positive the participants evaluated speeding (see section 6.3.5 for a full description of the measures). Following the procedure used in study 2, the purpose of the bi-polar unidimensional attitude measure, along with the pre-intervention measure of speeding behaviour, was to screen the participants to ensure they were eligible to continue with the study. In this study, the participants were deemed eligible to continue if they reported both exceeding the speed limit on a regular enough basis to justify giving them an intervention designed to reduce their speeding behaviour. As in study 2, this was operationally defined as scoring the scale mid-point or above on 5 of more of the behaviour items, meaning that at least moderate levels of speeding behaviour were reported in a quarter of the driving situations that comprised the pre-intervention behaviour measure. They also had to have negative attitudes towards speeding, which needed to be converted into safe driving from a road safety perspective (operationally defined as scoring below the scale mid-point on the negative-positive bipolar, unidimensional attitude measure; this was unlike study 2, in which participants with positive attitudes towards speeding were retained; see chapter 5).

N = 673 participants completed the pre-intervention measures of speeding behaviour and explicit attitudes towards speeding. *N* = 257 of these participants met the eligibility criteria. These participants were therefore contacted, using email addresses that they provided within the questionnaire, and invited to the Driver Behaviour Laboratory, situated in the School of Psychological Sciences and Health, to take part in the next stage of the study. *N* = 164 (63.81%) participants accepted this invitation and visited the laboratory (see Figure 6.1). In addition, as indicated in Figure 6.1, *N* = 226 participants were not eligible for study 3, but they were eligible for study 2. Therefore, as indicated in chapter 5, in order to maximise recruitment, these participants were invited to take part in the next stage of study 2 (see chapter 5).

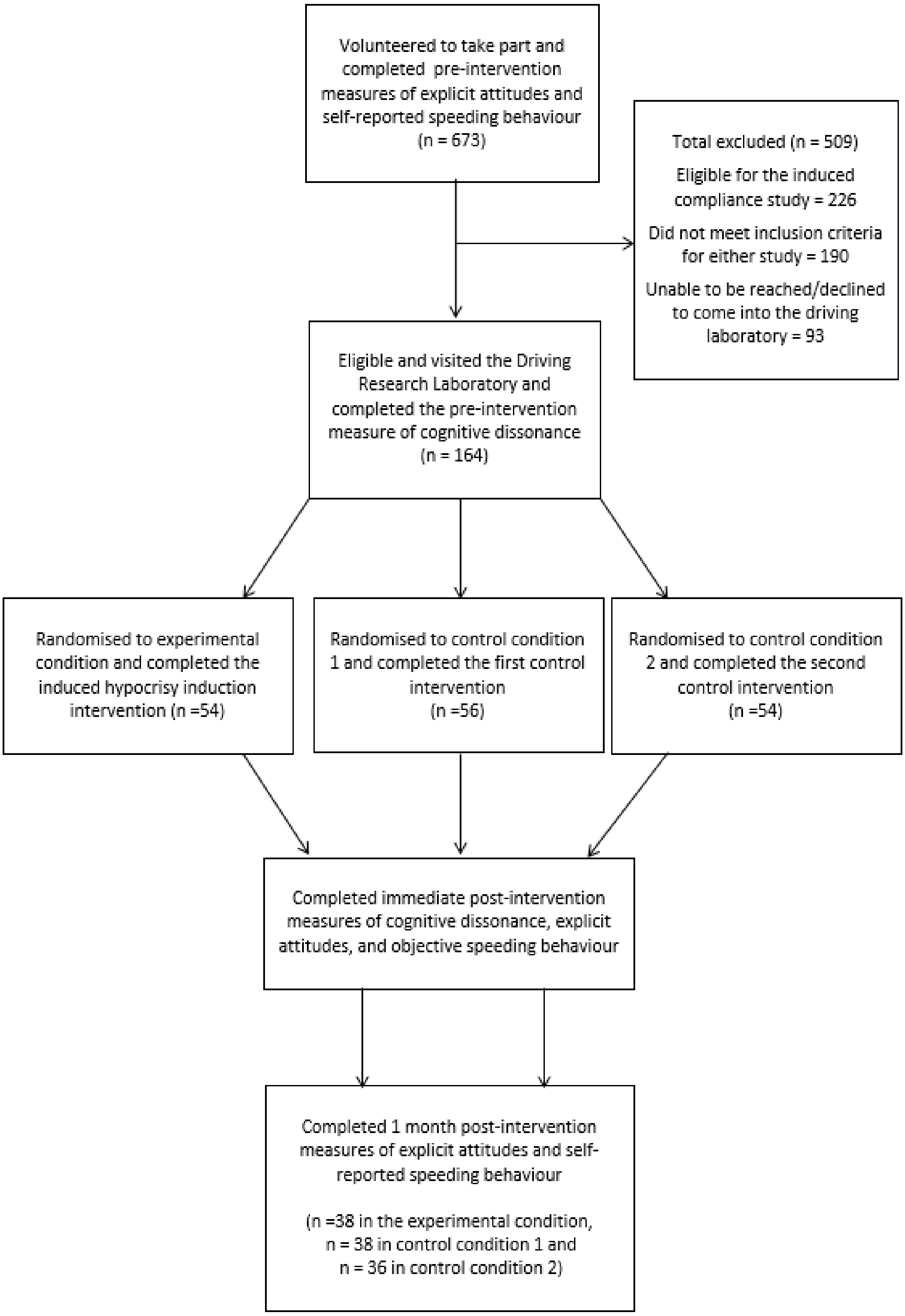

Figure 6.1: Flow chart showing the participants' progress through the study

When the participants arrived at the Driver Behaviour Laboratory, they were asked to complete a short questionnaire designed to measure pre-intervention levels of cognitive dissonance using Elliot and Devine (1994)'s dissonance thermometer (see section 6.3.5). As shown in Figure 6.1, the participants were then allocated at randomly to either an experimental condition (*n* = 54) or one of two control conditions (*n* = 56 in control condition 1 and *n* = 54 in control condition 2). The participants were randomised to the conditions using a random number generator. The participants randomised to the experimental condition were given the hypocrisy induction intervention. In line with the literature on cognitive dissonance, this was an attitude-saliency sub-task and a mindfulness sub-task (see section 6.3.3 below). The participants randomised to the control conditions were given control interventions that were not designed to induce cognitive dissonance (see section 6.3.4 below). Immediately post- intervention, all of the participants completed a questionnaire that contained the same items as used at pre-intervention to measure their cognitive dissonance. They also completed a questionnaire containing the same items as used at pre-intervention to measure both the positive and negative dimensions of their explicit attitudes towards speeding. Following the questionnaires, all the participants drove on a driving simulator to obtain an objective measure of speeding behaviour immediately after the intervention.[10]

[10] Note that it was not necessary in this study to measure implicit attitudes towards speeding because hypocrisy induction interventions are not designed to modify attitudes and implicit attitudes measures are time consuming from a participants point of view (see chapters 4 and 5). Explicit attitude measures were deemed

One month post-intervention, all of the participants who attended the Driving Research Laboratory were sent a link to an online follow-up questionnaire. This questionnaire contained the same items as at pre- and immediate post-intervention to measure the positive and negative dimensions of explicit attitudes towards speeding and the same items as at pre-intervention to measure self-reported speeding behaviour. After completing this questionnaire, participants were thanked for taking part, were debriefed fully about the study, and were given the opportunity to withdraw their data because of the deception involved in the study. No participants opted to withdraw their data.

As shown in Figure 6.1, *n* = 112 participants (68.29%) completed the one-month post-intervention measures (*n* = 38 in the experimental condition, *n* = 38 in control condition 1, and *n* = 36 in control condition 2). The data across the three stages of the study (pre-, immediate post- and one-month post- intervention) were matched by using unique identifiers that were given to each participant on all questionnaires and driving simulator databases. The participants who were recruited from the University and formed part of the Psychology Participant Pool (years 1, 2 and 3 of the BA Psychology degree programme) received a course credit for participation in the research. All other participants received no incentive for taking part.

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sufficient to rule out the possibility that the present hypocrisy induction intervention did not engender attitude-change. As shown in study 1 (chapter 4), explicit attitudes are stronger predictors of speeding than are implicit attitudes and they do not place an undue burden on participants.

6.3.3 The Hypocrisy Induction Intervention

The participants randomised to the experimental condition were given a hypocrisy induction intervention. First, the participants were told that their scores on the initial (pre-intervention) online questionnaire showed that they had socially desirable attitudes (i.e., attitudes that are against the act of exceeding the speed limit) but that they exceed the speed limit, at least on occasion. Next, the participants were told that their help was needed to design materials to promote safer driving. To help them do this, they were asked to complete an attitude-saliency sub-task. They were shown a list of ten reasons that drivers often cite for why they comply with the speed limit. These ten reasons are summarised in Table 6.1 and were derived from the literature on driver behaviour (e.g., Elliott et al., 2005; Kanellaidis et al., 1995; Parker et al., 1992). The participants were asked to select the five most important reasons for why they personally think that driving within the speed limit is a generally desirable behaviour. They were then asked to put those reasons in order from 1 (the most important reason) to 5 (the least important reason).

Table 6.1 Reasons for complying with the speed limit presented to drivers in the attitude saliency sub-task

Reasons for complying	Proportion of experimental participants who chose the reason	Proportion of control group 1 participants who chose the reason
Complying with the speed limit puts pedestrians and other road users at less risk	88.90%	89.30%
Complying with the speed limit reduces my chances of an accident	79.60%	83.90%
Complying with the speed limit uses less fuel	11.10%	1.80%
Complying with the speed limit makes me feel relaxed	5.60%	3.60%
Complying with the speed limit makes me feel safer	31.50%	26.80%
Complying with the speed limit makes it easier to detect hazards	66.70%	58.90%
Complying with the speed limit makes me feel more in control of my vehicle	48.10%	55.40%
Complying with the speed limit makes me a safer driver	46.30%	46.40%
Complying with the speed limit means I avoid speeding fines/getting stopped by the police	42.60%	55.40%
Complying with the speed limit puts any passengers in my car at less risk	79.60%	80.40%

The rationale for this task came from the literature on attitude formation. According to this literature, attitudes (global positive or negative evaluations of a behaviour) are held to be based on underlying beliefs about the consequences of behaviour (e.g., Fishbein, 1963; Fishbein & Ajzen, 1975). Research across several domains (e.g., French, Cooper, & Weinman, 2006; Kasim, Al-Zalabani, Abd El-Moneim, & Abd El-Moneim, 2016), including driving (e.g., Elliott et al., 2005; Parker et al., 1996; Rowe et al., 2016) (Warner & Åberg, 2008) supports this theoretical contention by showing that measures of beliefs about behavioural consequences account for substantial proportions of variance in measures of global (i.e., overall) attitudes. Asking the participants to indicate the reasons why they thought complying with the speed limit was designed to make salient the positive consequences that they associated with speeding and therefore the beliefs that were likely to be the basis for their desirable attitudes as indicated in the pre-intervention questionnaire. The rationale for why the participants were asked to select 5 reasons for why they felt complying with the speed limit was important came from the literature on belief saliency. According to this literature, out of all the beliefs that individuals have about the consequences of a behaviour only some are salient at any one time and typically the five most salient beliefs are the ones that are most likely to dictate attitudes (Agnew, 1998; Budd, 1986; van der Pligt & de Vries, 1998; van der Pligt & Eiser, 1984).

Next, the participants were asked to complete a mindfulness sub-task, designed to make them explicitly aware of how their behaviour was not consistent with their stated attitudes. They were shown a list of 20 driving situations (see Table 6.2) and asked to select the five in which they had exceeded the speed limit most often over the last month. They were asked to rank the five situations from 1 (the situation in which they most often exceeded the speed limit) to 5 (the situation in which they had least often exceeded the speed limit). The 20 driving situations were the same as the situations used in the screening questionnaire to measure pre-intervention behaviour because they provide a comprehensive range of driving situations in which drivers exceed the speed limit, as identified by previous research (e.g., Brewster et al., 2015).

Table 6.2 List of 20 driving situations

Driving situations
Driving when I am being overtaken by other traffic/another vehicle
Driving when I am trying to keep up with surrounding traffic
Driving when I feel under pressure from another driver following close behind me
Driving when another driver is putting pressure on me to drive faster by flashing their headlights/sounding their horn
Driving after I have been ‘stuck’ in stationary traffic
Driving after I have been ‘stuck’ behind a slow moving vehicle
Driving on roads with little or no traffic
Driving when traffic lights have just turned against me
Driving on roads that I think should have higher speed limits
Driving when I am listening to certain types of music in the car
Driving on a long journey
Driving when I feel stressed
Driving when I am carrying passengers who are encouraging me to drive faster (overtly or otherwise)
Driving when I feel like showing-off or asserting myself
Driving when I am late or in a hurry to get somewhere (e.g., work/university/an appointment/to meet friends
Driving on familiar roads
Driving when I feel like there is little chance of being caught for speeding
Driving when I feel like the car ‘wants’ to go faster
Driving past a school
Driving down a road with parked cars

The reason why the participants were asked to select the five situations in which they had exceeded the speed limit most often over the last month stemmed mainly from the research reviewed in chapter 3, which showed that counter-attitudinal behaviour needs to be attributed internally, rather than externally, in order to induce cognitive dissonance. Research in social psychology on attributions (McArthur, 1972) shows that internal attributions for behaviour tend to increase and, conversely, external attributions for behaviour tend to decrease with the extent to which behaviour is consistent (i.e.., performed often) and non-distinctive (i.e., performed over different situations not just one specific situation or narrow range of situations). Thus, asking participants to state their counter-attitudinal behaviour over multiple situations should induce greater cognitive dissonance. Additionally, previous research has shown that cognitive dissonance tends to be more readily induced with hypocrisy induction interventions when mindfulness tasks require participants to recall their counter-attitudinal behaviour in more than just 1 or 2 situations (e.g., Fointiat, Morisot, & Pakuszewski, 2008; Stone & Focella, 2011). However, asking the participants to recall their counter-attitudinal behaviour in too many situations was deemed to be problematic on the basis that counter-attitudinal behaviour in each situation needs to be mentally processed in order for it to contribute towards mindfulness. In other words, specifying a situation in which one exceeds the speed limit is only likely to contribute towards one becoming mindful that one's behaviour is not consistent with one's attitude if mental processing of one's behaviour in the specified situation occurs (Greenwald, 1968). Research into working memory (e.g., Miller, 1956) shows that individuals are typically able to process between five and nine (seven plus or minus two) items at any one time.

Given individual variation in cognitive capacities (e.g., Barrett, Tugade, & Engle, 2004), the lower estimate of five items informed the hypocrisy induction intervention in this study to help ensure that all participants had the opportunity to process the situations in which they had behaved counter to their attitudes over the past month. Thus, the participants were asked to recall their counter-attitudinal behaviour in five situations.

6.3.4 The Control Interventions

As stated above, there were two control conditions in this study. The participants randomised to control condition 1 were given a virtually identical task to the experimental condition. They were told that their scores on the initial online questionnaire showed that they had socially desirable attitudes (i.e., attitudes that are against the act of exceeding the speed limit) and they completed the attitude-saliency sub-task under the same conditions as the experimental participants (see above). Next, the participants were asked to complete a no-mindfulness sub-task where they were shown the same list of 20 driving situations as the experimental condition (see Table 5.2) but instead of being asked to select the five situations in which they had most often exceeded the speed limit in the last month (i.e., state when they had performed counter-attitudinal behaviour) they were asked to select the five situations in which they thought it was most important to comply with the speed limit. In contrast to the experimental condition, therefore, the participants in this control condition were not given a task to make them mindful of their counter-attitudinal behaviour, meaning that cognitive dissonance should not have been induced. However, they were still asked to think about the same driving situations as the experimental condition and, to keep the task demand completely consistent with the experimental condition, the participants in this control condition were asked to rank the five situations from 1 (the situation in which thought it was most important to comply with the speed limit) to 5 (the situation in which thought it was least important to comply with the speed limit).

The participants randomised to control condition 2 were asked to read a safety information sheet about the effects of speeding and its role in traffic accidents. This information sheet was the same as the one used in the control condition for study 2 (chapter 5) and was based on an intervention by Elliott and Armitage (2009), which presented persuasive arguments designed to modify attitudes and other social cognitive constructs with regard to speeding. The rationale for the use of this control condition was that the participants in control condition 1 might have experienced cognitive dissonance even though the task they were given was not designed to do so. Specifically, the participants in control condition 1 may have spontaneously reflected upon their counter-attitudinal behaviour (speeding) when completing the no-mindfulness task, even though they were not instructed to, because the behavioural situations they were presented with might have inadvertently primed behaviour-relevant thoughts (e.g., A. Clarke, Bell, & Peterson, 1999). Control condition 2 was necessary to help rule out this possibility.

6.3.5 Measures

6.3.5.1 Cognitive dissonance

Although the previous chapter discusses that the dissonance thermometer (Elliot & Devine, 1994) may not be sensitive enough to detect cognitive dissonance, as study 3 was conducted simultaneously with study 2, the dissonance thermometer was used in this study to measure cognitive dissonance. In line with Elliot and

Devine (1994), the participants were asked to "Please indicate how you are feeling right now". They were then presented with three target items that measure cognitive dissonance (uneasy, bothered and uncomfortable) amongst 12 other items (see Appendix E). The participants responded to each item on a 9-point scale from "Does not apply at all" (scored 1) to "Applies very much" (scored 9). The mean of the three target items was calculated and used as the final measure of cognitive dissonance at both pre-intervention (Cronbach's $\alpha = 0.68$) and immediate post-intervention (Cronbach's $\alpha = 0.79$).

6.3.5.2 Explicit Attitudes

As in studies 1 and 2, the split semantic differential technique (Kaplan, 1972) was used to measure the positive and negative dimensions of explicit (bi-dimensional) attitudes. Six items were used to measure the positive dimension of explicit attitudes. The participants were asked to (1) "Think only about the fun outcomes that you associate with speeding" and to rate "How fun are they?"; (2) "Think only about the enjoyable outcomes that you associate with speeding" and to rate "How enjoyable are they?", (3) "Think only about the rewarding outcomes that you associate with speeding" and to rate "How rewarding are they?"; (4) "Think only about the pleasant outcomes that you associate with speeding" and to rate "How pleasant are they?", (5) "Think only about the beneficial outcomes that you associate with speeding" and to rate "How beneficial are they?"; (6) "Think only about the positive outcomes that you associate with speeding" and to rate "How positive are they?". The participants' ratings were provided on 9-point unipolar scales, for example, from "not at all fun (scored 1) to "extremely fun" (scored 9). The mean of the six items was calculated and used as the final measure of the explicit positive attitude dimension at pre-intervention (Cronbach's α = 0.80), immediate post-intervention (Cronbach's α = 0.86) and one-month post-intervention (Cronbach's α = 0.89). Higher scores indicated that the positive outcomes of speeding were rated more positively.

Six items were also used to measure the negative dimension of attitude. The participants were asked to (1) "Think only about the boring outcomes that you associate with speeding" and to rate "How boring are they?"; (2) "Think only about the unenjoyable outcomes that you associate with speeding" and to rate "How unenjoyable are they?", (3) "Think only about the unrewarding outcomes that you associate with speeding" and to rate "How unrewarding are they?"; (4) "Think only about the unpleasant outcomes that you associate with speeding" and to rate "How unpleasant are they?", (5) "Think only about the harmful outcomes that you associate with speeding" and to rate "How harmful are they?"; (6) "Think only about the negative outcomes that you associate with speeding" and to rate "How negative are they?". The participants' ratings were provided on 9-point unipolar scales, for example, from "not at all boring (scored 1) to "extremely boring" (scored 9). However, as the reliability of this measure was low for the pre-intervention questionnaire (Cronbach's α = 0.58), one item was removed ("Think only about the boring outcomes that you associate with speeding" and to rate "How boring are they?") in order to increase the reliability to an acceptable level. The mean of the remaining five items was therefore calculated and used as the final measure of the explicit negative attitude dimension at pre-intervention questionnaire (Cronbach's α = 0.68), immediate post-intervention (Cronbach's α = 0.67) and one-month post-intervention (Cronbach's α = 0.80). Higher scores indicated that the negative outcomes of speeding were rated more negatively. It should be noted that the findings were the same regardless of whether the five or six item measure was used in the analysis.

As reported in section 6.3.2, a pre-intervention measure of unidimensional attitudes towards speeding was taken and used solely for the purpose of screening the participants (see section 6.3.2). As in study 2, standard questionnaire items (i.e., commonly employed in the literature and shown to produce reliable measures) were used. The participants were asked to respond to six items using 9-point scales. The participants were presented with the item stem: "For me, speeding whilst driving over the next month would be…" They were asked to complete the stem using bipolar semantic differential scales from "extremely boring" (scored 1) to "extremely fun" (scored 9); from "extremely unenjoyable" (scored 1) to "extremely enjoyable" (scored 9); from "extremely unrewarding" (scored 1) to "extremely rewarding" (scored 9); from "extremely unpleasant" (scored 1) to "extremely pleasant" (scored 9); from "extremely harmful" (scored 1) to "extremely beneficial" (scored 9); and from "extremely negative" (scored 1) to "extremely positive" (scored 9). The mean of the six items was calculated and used to screen the participants as described in section 6.3.2 (Cronbach's alpha of $\alpha = 0.72$).

6.3.5.3 Speeding behaviour

Speeding behaviour was measured at pre-intervention and one-month post-intervention using the same 20-item self-reported scale employed in study 2. Although the previous chapter discusses that future research might usefully measure speeding objectively one-month post-intervention, as study 3 was conducted simultaneously with study 2, the self-reported scale was used in this study to measure one-month post-intervention speeding behaviour. The participants were asked to indicate how often they exceed the speed limit in a comprehensive range of driving situations as identified from the literature on road safety (see Brewster et al., 2015). The participants were asked: “When you encounter the following situations, how often do you find yourself driving faster than the speed limit?” They were then presented with the 20 driving situations shown in Table 6.2. The participants indicated their responses on scales ranging from 1 (never) to 9 (very often). The mean of the 20 items provided a reliable measure of speeding behaviour at pre-intervention (Cronbach’s $\alpha = 0.84$) and one-month post-intervention (Cronbach’s $\alpha = 0.89$).

Speeding behaviour was measured at immediate post-intervention using a driving simulator. At immediate post-intervention, speeding behaviour was measured using a driving simulator. The driving simulator used in this study was the same STISIM Drive Model 400W fixed-based driving simulator used in study 1 and study 2 (see chapter 4, section 4.3.5 and chapter 5, section 5.3.5.4 and see Appendix C). The trial route and the procedure for collecting the data, including a 5-minute practice drive prior to the trial route proper, was the same as in study 1 and study 2. Specifically, the participants were initially given a five-minute practice drive to get used to the simulator controls. Following the practice drive, the participants completed the trial route, which comprised a 7.06-mile section of road through an urban environment. Prior to driving the trial route, the participants were told to treat the drive as if it were a real drive in the real world. They were told that the speed limit was 30mph and to drive straight ahead (i.e., not to turn at any junctions). The trial route comprised junctions, zebra crossings, and traffic modelled in the oncoming lane in order to increase the fidelity of the drive. No traffic were modelled in the driving lane and no pedestrians were programmed to cross the road at any of the zebra crossings, allowing participants to freely choose their driving speed without constraint. The measure of speeding behaviour used in the data analysis was the percentage of the trial route that the participants spent driving over the 30mph speed limit. As in study 1 and 2, this was operationalised as 30.50mph in order to prevent micro-fluctuations in speed around 30mph from unduly influencing the results. The mean speed for each participant was also extracted from the simulator as an additional behaviour measure.

6.3.6 Statistical analysis

Data analysis was conducted using SPSS statistical analysis software. To determine if there were any effects of attrition, a series of one-way ANOVAs were conducted to test the differences between the groups (e.g., the difference between those who dropped out of the study following the pre-intervention and those who completed the next stage). In addition, to determine if randomisation to conditions had been successful, a series of one-way ANOVAs were conducted to test the differences between the conditions on measures of attitude, behaviour, and cognitive dissonance. Also, in order to establish if there were any interaction effects between attrition and conditions, a series of two-way ANOVAs was also conducted to allow the interaction between groups and condition to be tested.

A series of ANCOVAs were conducted to establish if there were differences between the experimental and control conditions on the immediate post-intervention measure of cognitive dissonance, and the immediate and one-month post-intervention measures of behaviour. The rationale for using these one-way

ANCOVAs was that it allowed the differences between groups to be statistically tested (i.e., to test hypothesis 1 to hypothesis 3) whilst controlling for the relevant covariate, and did not produce information that was not required (e.g., interactions between different variables).

6.4 Results

6.4.1. Power analysis

Power analysis indicated that to detect a meaningful sized effect (f= .25) at $\alpha = 0.05$ with power = 0.80, the required sample size was n = 158. The present study was therefore sufficiently powered for testing the hypotheses relating to pre- and immediate-post intervention measures (hypotheses 1, 2 and 4) without unduly risking a type 1 error because the number of participants who completed the pre- and immediate post-intervention measures was n = 164 (see Figure 6.1). The number of participants who completed the one-month post-intervention measures was n =112 (see Figure 6.1), which was less than the required sample size. I return to this issue in the discussion section of this chapter.

6.4.2. Tests of attrition and randomisation to conditions

As described in the method, n = 257 participants were recruited for this study and completed a pre-intervention questionnaire to measure the positive and negative dimensions of their explicit attitudes towards speeding and their self-reported speeding behaviour. N = 164 of these participants accepted the invitation to the Driving Research Laboratory to take part in the next stage of the study. These participants comprised the full sample, which was used to test the hypotheses relating to the immediate post-intervention measures (see participants section). Three one-way ANOVAs were therefore conducted to test whether there were any observed effects of attrition on the full sample. The dependent variables were the pre-intervention measures of the positive (ANOVA 1) and negative (ANOVA 2) explicit attitude dimensions and pre-intervention measure of (self-reported) speeding behaviour (ANOVA 3). The independent variable in each ANOVA was attrition (0 = dropped out of study following the pre-intervention questionnaire [n = 93]; 1 = completed the next stage of the study [n = 164]). As shown in Table 6.3.1, there were no differences between the study drop-outs and remainers on the pre-intervention measures of the positive dimension of explicit attitudes, the negative dimension of explicit attitudes or self-reported speeding behaviour, meaning that there were no observed pre- to immediate post-intervention attrition-related biases with regards to these measures.

Table 6.3.1. Tests of attrition and condition for the full sample of participants who completed the immediate post-intervention stage of the study

Dependent Variable	*F*	MS	*p*	Cohen's *f*
Attrition (0 = Completed baseline only [93]; 1 = Completed baseline and intervention [164])				
Pre-intervention positive dimension of explicit attitudes	3.57	7.37	0.060	0.12
Pre-intervention negative dimension of explicit attitudes	0.04	0.06	0.843	0.01
Pre-intervention speeding behaviour	0.03	0.03	0.871	0.02
Pre-intervention cognitive dissonance	N/A	N/A	N/A	N/A
Condition (1 = experimental [54]; 2 = first control [56]; 3 = second control [54])				
Pre-intervention positive dimension of explicit attitudes	0.70	1.37	0.500	0.09
Pre-intervention negative dimension of explicit attitudes	0.63	0.93	0.535	0.09
Pre-intervention speeding behaviour	9.00	10.27	< 0.001	0.32
Pre-intervention cognitive dissonance	0.46	0.43	0.632	0.08

*Note: the study drop outs at immediate post-intervention could not be compared with the participants who remained in the study at this stage because, unlike the other pre-intervention measures, cognitive dissonance was not measured until immediately prior to intervention, within the same session as intervention delivery and immediate post-intervention measurement (see method section).

The *n* = 164 participants who accepted the invitation to the Driving Research Laboratory completed a pre-intervention measure of cognitive dissonance and were randomised to either the experimental (*n* = 54), first control (*n* = 56) or second control (*n* = 54) conditions. They also completed post-intervention measures of cognitive dissonance, explicit attitudes (positive and negative dimensions) and objective speeding behaviour on the driving simulator. *N* = 112 (*n* = 38 experimental, *n* = 38 first control, and *n* = 36 second control) participants completed the one-month post-intervention stage of the study. These participants comprised the subsample, which was used to test the hypotheses relating to the one-month post-intervention measures (see participants section). A series of one-way ANOVAs was therefore conducted to test whether there were any observed effects of attrition on the subsample. Seven one-way ANOVAs were conducted in total. The dependent variables were the pre-intervention measures of the positive (ANOVA 1) and negative (ANOVA 2) dimensions of explicit attitudes, self-reported speeding behaviour (ANOVA 3) and cognitive dissonance (ANOVA 4), and the immediate post-intervention measures of the positive (ANOVA 5) and negative (ANOVA 6) dimensions of explicit attitudes, and objectively measured speeding behaviour on the driving simulator (ANOVA 7). The independent variable in each ANOVA was attrition (0 = dropped out of study following immediate post-intervention; 1 = completed the study). As shown in Table 6.3.2, there were no significant differences between those who dropped out of the study following the immediate post-intervention stage and those who completed the study, meaning that no attrition-related biases from immediate post- to one-month post-intervention were observed.

To test whether there were any differential effects of attrition between the conditions, a series of two-way ANOVAs was also conducted. The dependent variables were the pre-intervention measures of the positive (ANOVA 1) and negative (ANOVA 2) dimensions of explicit attitudes, self-reported speeding behaviour (ANOVA 3) and cognitive dissonance (ANOVA 4), and the immediate post-intervention measures of the positive (ANOVA 5) and negative (ANOVA 6) dimensions of explicit attitudes, and objectively measured speeding behaviour on the driving simulator (ANOVA 7). The independent variables were condition (1 = experimental, 2 = first control and 3 = second control) and attrition (0 = dropped out of the study following the immediate post-intervention stage; 1 = completed the study). As shown in Table 6.3.2, there was a significant interaction between attrition and condition for the post-intervention measure of negative explicit attitudes. Follow-up Bonferroni corrected t-tests showed that those in control condition 2 who dropped out of the study at follow-up had lower post-intervention negative explicit attitudes (p = 0.015) compared to those in control condition 2 who completed the study in full. I return to this issue in the discussion section of this chapter.

Table 6.3.2. Tests of attrition and condition for the one-month post-intervention subsample

Dependent Variable	*F*	MS	*p*	Cohen's *f*
Attrition (0 = Completed baseline and intervention only [52]; 1 = Completed baseline intervention and follow-up [112])				
Pre-intervention cognitive dissonance	0.73	0.68	0.394	0.07
Pre-intervention positive dimension of explicit attitudes	1.69	3.30	0.196	0.11
Pre-intervention negative dimension of explicit attitudes	0.05	0.07	0.825	0.02
Pre-intervention speeding behaviour	1.08	1.36	0.299	0.09
Immediate post-intervention cognitive dissonance	0.10	0.08	0.752	0.03
Immediate post-intervention positive dimension of explicit attitudes	0.76	1.93	0.384	0.07
Immediate post-intervention negative dimension of explicit attitudes	0.09	0.11	0.761	0.03
Immediate post-intervention speeding behaviour	0.56	0.03	0.456	0.07

Table 6.3.2. Tests of attrition and condition for the one-month post-intervention subsample (continued)

Dependent Variable	*F*	MS	*p*	Cohen's *f*
Condition (1 = experimental [38]; 2 = first control [38]; 3 = second control [36])				
Pre-intervention positive dimension of explicit attitudes	0.58	1.11	0.563	0.13
Pre-intervention negative dimension of explicit attitudes	0.98	1.35	0.380	0.38
Pre-intervention speeding behaviour	8.05	8.67	0.001	0.03
Pre-intervention cognitive dissonance	0.04	0.03	0.965	0.10
Immediate post-intervention cognitive dissonance	N/A	N/A	N/A	N/A
Immediate post-intervention positive dimension of explicit attitudes	N/A	N/A	N/A	N/A
Immediate post-intervention negative dimension of explicit attitudes	N/A	N/A	N/A	N/A
Immediate post-intervention positive dimension of implicit attitudes	N/A	N/A	N/A	N/A
Immediate post-intervention negative dimension of implicit attitudes	N/A	N/A	N/A	N/A
Immediate post-intervention speeding behaviour	N/A	N/A	N/A	N/A

Table 6.3.2. Tests of attrition and condition for the one-month post-intervention subsample (continued)

Dependent Variable	*F*	MS	*p*	Cohen's *f*
		Attrition x randomisation		
Pre-intervention positive dimension of explicit attitudes	0.23	0.46	0.792	0.05
Pre-intervention negative dimension of explicit attitudes	0.50	0.75	0.605	0.08
Pre-intervention speeding behaviour	0.28	0.33	0.755	0.06
Pre-intervention cognitive dissonance	1.49	1.38	0.230	0.14
Immediate post-intervention cognitive dissonance	0.69	0.56	0.504	0.09
Immediate post-intervention positive dimension of explicit attitudes	0.16	0.41	0.854	0.04
Immediate post-intervention negative dimension of explicit attitudes	3.98	4.55	0.021	0.22
Immediate post-intervention speeding behaviour	1.01	0.05	0.368	0.11

*Note: N/A: these measures were included in the analysis of condition only to permit the inclusion of the interactions with attrition. The differences between the conditions on the immediate post-intervention measures are not relevant to the issue of testing successful randomisation to condition because there are reasons to assume differences at immediate post-intervention (i.e., the intervention). The results relating to the differences between the conditions on the immediate post-intervention measures are therefore presented on sections 6.4.4 and 6.4.5 when testing the hypotheses.

To gauge whether randomisation to conditions was successful, a series of one-way ANOVAs was conducted to test whether there were any differences between the conditions on the pre-intervention measures. The dependent variables were the pre-intervention measures of the positive (ANOVA 1) and negative (ANOVA 2) dimensions of attitudes, self-reported speeding behaviour (ANOVA 3) and cognitive dissonance (ANOVA 4). The independent variable in each ANOVA was condition (1 = experimental, 2 = first control, and 3 = second control). It can be seen in Table 6.3.1 that when these analyses were run using the full sample of participants who completed the immediate-post-intervention measures (n = 164), there was a significant difference between the conditions on the pre-intervention measure of behaviour. Follow-up Bonferroni corrected t-tests showed that the significant differences were between the intervention condition (M = 4.07, SD = 0.93) and both the first (M = 4.88, SD = 1.13, p < 0.001, d = 0.78) and second (M = 4.74, SD = 1.13, p = 0.004, d = 0.65) control conditions, with the participants in the intervention condition reporting that they exceeded the speed limit less often (note that there was no significant difference between the two control conditions on the pre-intervention behaviour measure; p = 1.00, d = 0.12).

It can also be seen in Table 6.3.2 that when these analyses were run on just the subsample of the participants who completed the one-month post-intervention measures (n = 112), that a significant difference between the conditions on the pre-intervention measure of behaviour remained. Once again, follow-up Bonferroni corrected t-tests showed that the significant differences were between the participants in the intervention condition (M =3.97, SD = 0.79) and both the first (M = 4.88, SD = 1.13, p = 0.001, d = 0.93) and second (M = 4.67, SD = 1.16, p = 0.012, d = 0.72) control conditions, with the participants in the intervention condition reporting that they exceeded the speed limit less often than did the participants in the control conditions. Again, there was no significant difference between the participants in the two control conditions on the pre-intervention behaviour measure; $p = 1.00$, $d = 0.19$.

Given that the above baseline differences between conditions on pre-intervention behaviour might potentially explain any follow-up differences in speeding behaviour the pre-intervention behaviour measure was used as a covariate in the subsequent analyses in which the effects of the hypocrisy induction intervention were tested.

6.4.3 Descriptive statistics

The means and standard deviations for all measures are shown in Table 6.3.3 for the experimental and two control conditions, separately. The means on the measures of cognitive dissonance were below the scale mid-point at both pre- and immediate post intervention, meaning that the participants on average felt low levels of cognitive dissonance across all stages of the study. The means on the measure of positive explicit attitudes were below the scale mid-point at pre-, immediate-, and one-month post intervention, meaning that the participants, on average, rated the positive outcomes of speeding as not very positive. The means on the measure of negative explicit attitudes were above the scale mid-point at pre-, immediate-, and one-month post intervention, meaning that the participants, on average, rated the negative outcomes of speeding as moderately-to-highly negative. The means on the measure of self-reported speeding were close to the scale mid-point at both pre- and one-month post intervention, meaning that the participants, on average, reported that they exceeded the speed limit moderately often. At immediate post-intervention, the means on the objective measure of speeding behaviour from the driving simulator were 0.12 for the experimental condition, 0.20 for control condition 1 and 0.25 for control condition 2, meaning that, on average, the participants in the experimental condition exceeded the speed limit for 12% of the simulator drive, the participants in control condition 1 exceeded the speed limit for 20% of the simulator drive and the participants in control condition 2 exceeded the speed limit for 25% of the simulator drive.

It is worth pointing out that, in line with expectations, the mean for the immediate post-intervention speeding behaviour (driving simulator) measure was lower for the experimental condition than it was for both the control conditions, as was the mean for the one-month post-intervention speeding behaviour (self-reported) measure (see Table 6.3.3).

Table 6.3.3. Descriptive statistics and AN(C)OVA output

Variables	*M (SD)*			AN(C)OVA[a]			
	Experimental condition	Control condition 1	Control condition 2	*F*	*Df*	*P*	Cohen's *f*
			Pre-intervention (n = 164)				
Cognitive dissonance	1.73 (0.89)	1.89 (1.02)	1.88 (0.97)	0.46	(1, 161)	0.632	0.006
Positive explicit attitudes	3.48 (1.46)	3.78 (1.36)	3.53 (1.39)	0.70	(1, 161)	0.500	0.009
Negative explicit attitudes	7.47 (1.03)	7.23 (1.40)	7.42 (1.17)	0.63	(1, 161)	0.535	0.008
Speeding behaviour	4.07 (0.93)	4.88 (1.13)	4.74 (1.13)	9.00	(1, 161)	< 0.001	0.32
			Immediate post-intervention (n = 164)				
Cognitive dissonance	1.54 (0.74)	1.65 (0.98)	1.78 (0.96)	0.52	(1, 161)	0.594	0.08
Positive explicit attitudes	3.53 (1.52)	3.67 (1.76)	3.49 (1.50)	0.15	(1, 161)	0.859	0.04
Negative explicit attitudes	7.66 (1.00)	7.74 (1.11)	7.66 (1.14)	0.08	(1, 161)	0.920	0.03
Speeding behaviour	0.10 (0.13)	0.22 (0.25)	0.26 (0.27)	4.43	(1, 161)	0.013	0.24
			One-month post-intervention (n = 112)				
Positive explicit attitudes	3.32 (1.50)	3.48 (1.59)	3.61 (1.86)	0.33	(1, 108)	0.721	0.08
Negative explicit attitudes	7.55 (1.14)	7.52 (1.37)	7.76 (1.27)	0.38	(1, 108)	0.686	0.08
Speeding behaviour	3.42 (1.05)	4.32 (1.02)	4.58 (1.29)	5.42	(1, 108)	0.006	0.32

[a] The results for the pre-intervention measures are from one-way ANOVAs; due to the significant difference between conditions on the pre-intervention measure of speeding behaviour, the results for the post-intervention measures are from one-way ANCOVAs in which the pre-intervention measure of speeding behaviour was the covariate (see section 6.4.2).

6.4.4 Effects of the hypocrisy induction intervention on immediate post-intervention cognitive dissonance

A one-way ANCOVA was conducted to test the hypothesis that the participants randomised to the experimental (hypocrisy induction intervention) condition would report significantly greater levels of cognitive dissonance than would the participants randomised to the control conditions immediately following intervention (hypothesis 1). The dependent variable was the immediate post-intervention measure of cognitive dissonance. The independent variable was condition (1 = experimental condition; 2 = control condition 1; 3 = control condition 2). Pre-intervention speeding behaviour was the covariate. Table 6.3.3 shows that there was no detectable difference between the conditions on the immediate post-intervention measure of cognitive dissonance. Thus, the null was accepted for hypothesis 1.

6.4.5 Effects of the hypocrisy induction intervention on immediate post-intervention behaviour

A one-way ANOVA was conducted to test hypothesis 2: that the participants randomised to the experimental condition would exceed the speed limit significantly less frequently than would the participants randomised to the control conditions at immediate post-intervention. The dependent variable was the immediate post-intervention measure of speeding behaviour from the driving simulator. The independent variable was condition (1 = experimental condition; 2 = control condition 1; 3 = control condition 2). Pre-intervention speeding behaviour was the covariate. As shown in Table 6.3.3, the ANOVA revealed a significant main effect of condition on the immediate post-intervention measure of speeding behaviour in the driving simulator (see Figure 6.2). Thus, the null was rejected for hypothesis 2.

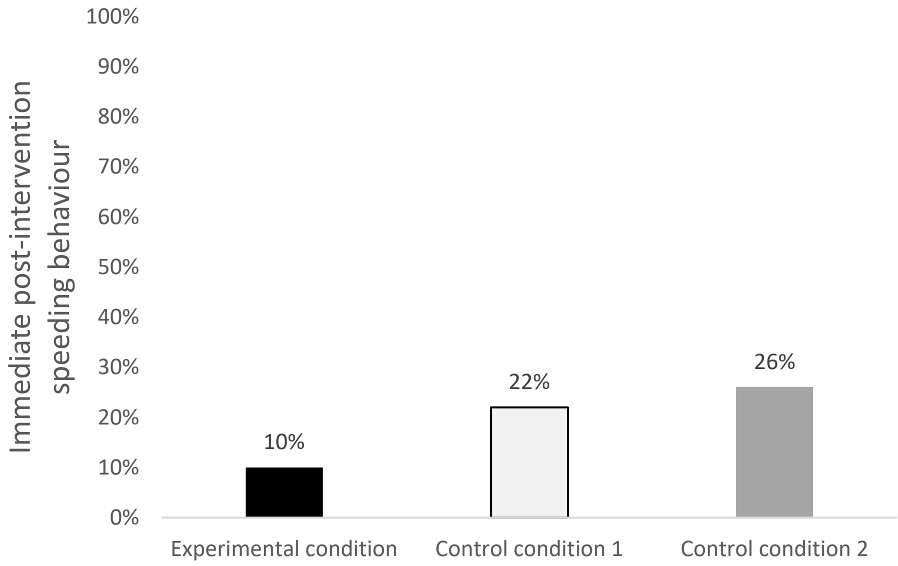

Figure 6.2: The effect of condition on immediate post-intervention speeding behaviour

Follow-up Bonferroni corrected t-tests showed that there was a significant difference between the participants in the intervention condition (*EM* = 0.12; *SE* = 0.03) and the participants in control condition 2 (*EM* = 0.25; *SE* = 0.03) on immediate post-intervention behaviour, with those in the intervention condition exceeding the speed limit less often ($p = 0.011$, $d = 0.60$). However, there was no significant difference between the intervention and control condition 1 (*EM* = 0.20; *SE* = 0.03; $p = 0.170$, $d = 0.37$). There was also no significant difference between the two control conditions ($p = 0.875$, $d = 0.23$).

To rule out the possibility that the difference between the experimental condition and control condition 2 on the measure of speeding behaviour at immediate post-intervention was attributable to the hypocrisy indication intervention generating unhypothesised changes in attitudes, two additional one-way ANCOVAs were conducted to test whether there were differences between the conditions on the explicit measures of the positive and negative dimensions of attitude. The dependent variables in these analyses were the immediate post-intervention measures of the positive dimension of explicit attitudes (AVCOVA 1) and the negative dimension of explicit attitudes (ANCOVA 2). The independent variable in both analyses was condition (1 = experimental condition; 2 = control condition 1; 3 = control condition 2). Pre-intervention speeding behaviour was the covariate in each analysis. As shown in Table 6.3.3, these ANCOVAs revealed no significant effect of condition on either the positive or negative dimension of explicit attitudes.

6.4.6 Effects of the hypocrisy induction intervention on one-month post-intervention behaviour

A one-way ANCOVA was conducted to test the hypothesis that the participants randomised to the experimental condition would exceed the speed limit significantly less frequently than would the participants randomised to the control conditions at one-month post-intervention (hypothesis 3). The dependent variable was the one-month post-intervention measure of (self-reported) speeding behaviour. The independent variable was condition (1 = experimental condition; 2 = control condition 1; 3 = control condition 2). Pre-intervention speeding behaviour was the covariate. As shown in Table 6.3.3, the ANOVA revealed a significant effect of condition on the one-month post-intervention measure of speeding behaviour (see Figure 6.3). Thus, the null was rejected for hypothesis 3.

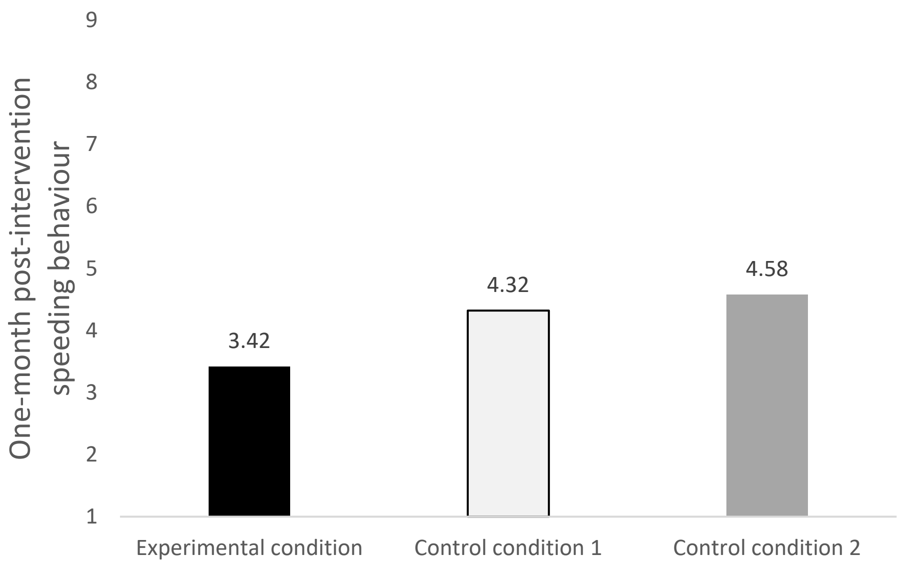

Figure 6.3: The effect of condition on one-month post-intervention speeding behaviour

Follow-up Bonferroni corrected t-tests showed that there was a significant difference between the participants in the intervention condition (*EM* = 3.73; *SE* =0.16) and the participants in control condition 2 (*EM* = 4.48; *SE* = 0.16) on the one-month post-intervention behaviour measure, with those in the intervention condition exceeding the speed limit less often (p = 0.004, d = 0.80). However, as was the case at immediate post-intervention, there was no significant difference between the intervention condition and control condition 1 (*EM* = 4.10; *SE* = 0.16) at one-month post-intervention (p = 0.336, d = 0.39) and there was no significant difference between the two control conditions (p = 0.262, d = 0.40).

Again, two additional one-way ANCOVAs were conducted to test whether there were differences between the conditions on the explicit measures of the positive and negative dimensions of attitude and thus rule out the possibility that the difference between the experimental condition and control condition 2 on the measure of speeding behaviour at one-month post-intervention was attributable to the hypocrisy indication intervention generating unhypothesised changes in attitudes. The dependent variables were the one-month post-intervention measure of the positive dimension of explicit attitudes (ANCOVA 1) and negative dimension of explicit attitudes (ANCOVA 2). The independent variable in both analyses was condition (1 = experimental condition; 2 = control condition 1; 3 = control condition 2). Pre-intervention speeding behaviour was the covariate each analysis. As shown in Table 6.3.3, these ANCOVAs revealed no significant effect of condition on either the positive or negative dimension of explicit attitudes.

6.4.7 Mediating effects of cognitive dissonance on behaviour

Hypotheses 4 and 5 (that the measure of cognitive dissonance would mediate any effects of the intervention on both the immediate post-intervention [hypothesis 4] and one-month post-intervention [hypothesis 5] behaviour measures) were not tested because there was no detectable difference between the conditions on the measure of cognitive dissonance (see section 6.4.4), meaning that any significant mediation effect would have been conceptually uninterpretable.

6.5 Discussion

The primary aim of the research reported in this chapter was to test a hypocrisy induction intervention that was designed to induce cognitive dissonance and thereby reduce drivers' speeding behaviour, bringing it in line with their generally desirable attitudes, which were against the act of speeding. At immediate post-intervention, it was hypothesized that: the participants randomised to the experimental (hypocrisy induction intervention) condition would report significantly greater levels of cognitive dissonance (hypothesis 1), and that they would exceed the speed limit significantly less frequently (hypothesis 2) than would the participants randomised to the control conditions. At one-month post-intervention, it was hypothesised that the participants randomised to the experimental condition would exceed the speed limit significantly less frequently than would the participants randomised to the control conditions (hypothesis 3). Given that hypocrisy induction interventions are theorised to generate cognitive dissonance, which in turn generates behaviour-change, it was also hypothesised that cognitive dissonance at immediate post-intervention would mediate the effects of condition (experimental versus controls) on both the immediate post-intervention (hypothesis 4) and one-month post-intervention (hypothesis 5) behaviour measures.

6.5.1 Immediate post-intervention effects of the hypocrisy induction intervention

The data provided evidence to accept the null for hypothesis 1 as the participants randomised to the experimental condition did not report significantly greater levels of cognitive dissonance than did the participants randomised to the control conditions. There was no evidence, therefore, that the hypocrisy induction intervention was successful at inducing cognitive dissonance. However, consistent with the discussion of the study 2 (chapter 5), cognitive dissonance was measured using the dissonance thermometer and it is possible that this measure is not sufficient for detecting cognitive dissonance following an hypocrisy induction intervention, such as the one developed in this study. This findings is also consistent with the small number of previous hypocrisy induction intervention studies in which researchers have measured cognitive dissonance directly, used the dissonance thermometer to do so, and found no differences between experimental and control participants (e.g., Chait, 2010; Simmons et al., 2004). Nevertheless, measures of cognitive dissonance have not even been collected in most previous studies (e.g., Dickerson et al., 1992; Fointiat, 2004; Fried, 1998: study 1; Fried & Aronson, 1995; Stone et al., 1994) and it is important to measure cognitive dissonance in order to permit direct tests of the theorised casual mechanism (i.e., cognitive dissonance) through which hypocrisy induction interventions engender behaviour-change, rather than to merely assume its presence from observed-changes in behaviour or behavioural proxies (see chapter 3). As discussed in chapter 5, physiological measures of arousal (e.g., galvanic skin responses) can be used to indicate emotional reactivity (e.g., Croyle & Cooper, 1983; Elkin & Leippe, 1986; Losch & Cacioppo, 1990) and may therefore provide more sensitive measures of cognitive dissonance than self-reported scales, such as the dissonance thermometer. Further research using physiological measures when testing hypocrisy induction interventions is needed to aid conclusions about whether these interventions can successfully induce cognitive dissonance.

Despite the null hypothesis being accepted for hypothesis 1, the data provided evidence to reject the null for hypothesis 2. At immediate post-intervention, the participants randomised to the experimental condition were not found to exceed the speed limit significantly less frequently on the driving simulator than were the participants randomised to the first control condition. However, they were found to exceed the speed limit less frequently than were the participants randomised to the second control condition. An explanation for why the experimental condition did not differ from the first control condition is that the tasks that the participants completed in these two conditions were too similar and triggered the same underlying psychological processes that engendered equivalent behaviour-change. As stated earlier, it is possible that the participants in both conditions experienced cognitive dissonance (not detected by the self-reported dissonance thermometer), with the dissonance induction occurring in the experimental condition through mindfulness of counter-attitudinal behaviour and the control condition through spontaneous thought-priming of counter-attitudinal behaviour (e.g., A. Clarke et al., 1999; see section 6.2.4). Alternatively, given the lack of evidence for the induction of cognitive dissonance in this study, it is possible that the tasks made both groups alter their behaviour to an equivalent extent, not through an affective process (e.g., the experience of cognitive dissonance) but an instrumental process. More specifically, it seems reasonable to assume that asking the participants to identify the situations in which they had recently exceeded the speed limit (experimental condition) or the situations in which all drivers should generally comply with the speed limit (control condition 1) may have increased the saliency of those situations in memory (e.g., Sheeran, Webb, & Gollwitzer, 2005). Subsequently, the participants may have been highly attuned to those situations, once encountered. The pairing those situations with the participants' anti-speeding attitudes (i.e., through the pairing of the attitude saliency and mindfulness subtasks) may have activated a behavioural strategy (e.g., the deployment of greater effort to avoid speeding) to ensure the appropriate (attitude-consistent) behaviour was performed (cf. Gollwitzer, 1993). Overall, it can be argued that regardless of the mechanism underlying this finding, an effective strategy to increase road safety involves asking drivers to reflect on their attitudes towards speeding and to identify driving situations that either they have recently exceeded the speed limit in, or that they know they should comply with the speed limit in.

Although there was no difference between the experimental condition and the first control condition in the frequency of speeding at immediate post-intervention, the experimental condition did exceed the speed limit significantly less frequently than the second control condition, in which the participants received an intervention containing road safety educational messages. The difference between the experimental and second control condition in the immediate post-intervention behaviour measure yielded an effect size of d = 0.60, which is conventionally accepted as a moderate-to-large sized difference (Cohen, 1992). This finding is consistent with previous studies in other domains in which hypocrisy induction interventions have been found to engender immediate post-intervention behaviour-change (e.g., Aronson et al., 1991; Fried, 1998: study 1; Fried & Aronson, 1995). It represents an important contribution to the literature because the only other study to have tested whether hypocrisy induction interventions can generate changes in driver behaviour is Fointiat (2004) and an imperfect proxy for behaviour was used in that study (i.e., behavioural willingness), which was not operationalised with regard to speeding or any other behaviour known to generate increased traffic crash risk. On the other hand, this study has shown that, at immediate post-intervention, the hypocrisy induction intervention led to lower levels of speeding behaviour in the experimental condition than did standard road safety educational messages in the control condition.

6.5.2 One-month post-intervention effects of the hypocrisy induction intervention

Consistent with the observed differences between the conditions at immediate post-intervention, the participants randomised to the experimental condition did not report exceeding the speed limit significantly less frequently at one-month post-intervention than did the participants randomised to the first control condition. However, they did report exceeding the speed limit significantly less often than did the participants randomised to the second control condition. The difference between the experimental and second control condition in the one-month post-intervention behaviour measure yielded an effect size of d = 0.80, which represents a large-sized difference (Cohen, 1992). This finding extends previous research in non-driving domains, which has typically focused on testing the immediate effects of hypocrisy induction interventions only (e.g., Aronson et al., 1991; Fried, 1998: study 1; Fried & Aronson, 1995). It also represents an important contribution to the literature on traffic psychology as it demonstrates, for the first time, that changes in drivers' speeding behaviour can be maintained over time following the delivery of an hypocrisy induction intervention (potential reasons for the lack of difference between the experimental condition and the first control condition are the same as at immediate post-intervention, discussed above).

6.5.3 Mediating effects of cognitive dissonance and attitudes

Hypotheses 4 and 5 (that the measure of cognitive dissonance would mediate any effects of the intervention on both the immediate post-intervention [hypothesis 4] and one-month post-intervention [hypothesis 5] behaviour measures) were not tested because there was no detectable difference between the conditions on the measure of cognitive dissonance (see section 6.4.4). It was not possible, therefore, for the observed differences between the conditions on the measures of behaviour at both immediate and one-month post-intervention to be attributable to cognitive dissonance. Future research is, therefore, needed to identify the theoretical mechanism underpinning the behaviour-change that can be brought about by a hypocrisy induction intervention. As discussed above, theoretical mechanisms could include cognitive dissonance as measured through physiological responses or instrumental processes.

6.5.4 Methodological considerations

Although this study provides evidence that a hypocrisy induction intervention can be used to modify drivers' subsequent speeding behaviour over and above information only interventions, the findings need to be interpreted in light of several methodological considerations. First, the power analysis reported in section 6.4.1 indicated that the required sample size for this study was n = 158 and while the pre- and immediate post-intervention measures were collected from a greater number of participants than this (n = 163), the one-month post-intervention measures were collected from fewer participants (n = 112). The potential risk therefore is that the null hypotheses relating to the post-intervention measures were incorrectly accepted (i.e., there was a potential risk of making a type 2 error). This was not an issue for the comparison between the experimental condition and the second control condition, in which the participants received standard road safety educational information because there was a significant difference between those two conditions on both the immediate and one-month post-intervention measures of behaviour, as hypothesised. Therefore, the null hypothesis was rejected, not accepted (i.e., there could be no type 2 error). It is possible that the analysis comparing the experimental condition and the first control condition, in which the participants received the attitude saliency and no mindfulness subtasks, was underpowered at one-month post-intervention leading to an incorrect acceptance of the null hypothesis. This seems unlikely, however, given the immediate post-intervention analyses were sufficiently powered and yielded comparable findings (i.e., a non-significant difference between these two conditions). Furthermore, the effect size estimate for the one-month post-intervention difference in speeding behaviour between the experimental condition and first control condition (Cohen's d, which is unbiased by sample size; see Cohen, 1992) was not large (d = 0.39).

A second methodological consideration is that there was a significant interaction between attrition and condition, on the immediate post-intervention measure of the negative dimension of explicit attitudes (see section 6.4.2). The interaction demonstrated that, in control condition 2 only, the participants who completed the study had more negative attitudes towards speeding than did the participants who dropped out at one-month post-intervention. However, this was unlikely to bias the results in favour of the observed intervention effect because the intervention's effect was specific to the measures of behaviour. Also, there was no detectable intervention effect on the measure of the negative attitude dimension at either immediate or one-month post-intervention. Note that there was also no detectable intervention effect on either the immediate or one-month post-intervention measure of the positive attitude dimension, for which no potential attrition related differences between the conditions were detected (see sections 6.4.5 and 6.4.6).

A third methodological consideration is that the effects of the hypocrisy induction intervention were tested over a one-month period. This raises the question of whether the intervention would have had longer lasting effects. However, as discussed in relation to the findings of study 2 (see chapter 5), previous research has shown that behaviour change observed after one month tends to persist (e.g., Armitage, 2005). Nevertheless, further research testing the potential longer-term effects of the hypocrisy induction intervention would be valuable.

A fourth methodological consideration is that the sample comprised largely of students. As discussed in the previous chapter for study 2, samples comprising university students are often criticised on the presumption that students may be more likely to be compliant with task demands (e.g., Jackson et al., 2005), which potentially increases the risk that results will be biased towards producing significant results in intervention studies such as this one. However, as was the case with the findings form study 2, the findings from this study are still held with confidence because previous research has shown that the findings from intervention studies are typically the same regardless of whether student or non-student samples are used (e.g., Gollwitzer & Sheeran, 2006a) and this was a randomised controlled study in which all participants (both experimental and control) received an intervention to equalise task demand.

6.5.5 Conclusions

In conclusion, the research reported in this chapter provided promising evidence for the efficacy of hypocrisy induction interventions that are designed to reduce drivers' subsequent speeding behaviour. Although no evidence was found to suggest that the hypocrisy induction intervention reduced speeding through the theoretical process of cognitive dissonance, it was encouraging that the intervention was found to generate behaviour-change immediately post-intervention and one-month later relative to standard road safety educational messages. Further research is needed to determine the theoretical mechanism underpinning the behaviour-change observed in this study.

Chapter 7: General Discussion

7.1 Chapter summary

This final chapter will summarise the research presented in this thesis, make conclusions for the efficacy of cognitive dissonance inducing interventions and discuss the implications for road safety. It will also discuss the contributions to knowledge.

7.2 Summary of the rationale for the research programme

Chapters 1 to 3 provided the background for the research programme reported in this thesis. Chapter 1 illustrated that road traffic crashes have a detrimental effect on road safety, the economy and health and wellbeing. Chapter 1 also demonstrated that speeding increases the risk of road traffic crashes and out of all driving violations it is the one that contributes the most to both fatal and non-fatal traffic-crash casualties. It was also discussed in Chapter 1 that despite the determinant effect speeding has, it is still a highly prevalent behaviour and current enforcement and road and vehicle engineering interventions tend to have effects that are restricted over time (e.g., once police presence has ceased) and distance (e.g., once an enforcement or traffic calming site has been passed). In addition, it was discussed that there is currently very limited evidence that previous road safety educational interventions have generated meaningful reductions in drivers' speeding behaviour (e.g., Department for Transport, 2013b; Glendon et al., 2014; Goldenbeld et al., 2008; Olumide & Owoaje, 2016). However, despite this, it was argued that educational interventions focus on attitude-change, and therefore they seek to control drivers' behaviour through internal forces (i.e. motivating drivers to refrain from speeding) rather than non-ubiquitous external forces (e.g., police presence, speed cameras and traffic calming). This means that, unlike enforcement and engineering strategies, they should have the capacity to generate longer lasting reductions in speeding behaviour over more of the road network, if effective intervention strategies can be found.

Chapter 2 focused on the reasons for why road safety educational interventions have, in general, not been shown to be effective at reducing drivers' speeding behaviour with a view to understanding ways in which it might be possible to increase intervention effectiveness. This included a review of social cognition (attitude-behaviour) models along with the associated empirical evidence, and a review of the relevant research on the different conceptualisations of the attitude construct and the prediction of behaviour from different types of attitudes. Chapter 2 also reviewed the literature on attitude-change interventions in the context of speeding and it was discussed that there was limited evidence showing that attitude-change interventions had been successful at generating changes in attitudes towards speeding or subsequent speeding behaviour. It was concluded in chapter 2, therefore, that research is needed to develop theoretically-based interventions to reduce drivers' speeding behaviour. Attitude-change interventions need to provide drivers with a direct experience, which has the scope to engender lasting modification of attitudes. On the basis of research showing a positivity bias in the prediction of behaviour from attitudes, these interventions are also likely to need to target the positive dimension of attitudes more so than the negative dimension. They may also need to change implicit attitudes in addition to explicit attitudes, although further research addressing this issue was suggested. In addition, it was concluded that different kinds of interventions are needed to reduce speeding for different kinds of drivers, with attitude-change interventions being needed for drivers with positive (socially undesirable) attitudes towards speeding and attitude-conversion interventions being needed for drivers with negative (socially desirable) attitudes.

Chapter 3 introduced cognitive dissonance theory (Festinger, 1957) as a theory that is well equipped to provide a basis for the development of attitude-change and attitude-conversion interventions. The two key paradigms within the literature on cognitive dissonance that are relevant with regards to the development of attitude-change (induced compliance) and attitude-conversion (hypocrisy induction interventions were described next, along with the status of the research evidence for each. Based on the theoretical and empirical evidence reviewed in chapters 1-3, the main aim of the research reported in this thesis was to develop and test, for the first time, induced compliance and hypocrisy induction interventions designed to reduce speeding. More generally, the research aimed to address the key limitations of previous research on other social behaviours in which cognitive dissonance inducing interventions have been tested by screening participants to ensure they are suitable for receiving an induced compliance (attitude-change required) or hypocrisy induction (attitude-conversion required) intervention, utilising measures of objective in addition to self-reported outcomes, and cognitive dissonance to test intervention effectiveness.

7.3 Summary of key findings

The research presented in Chapter 4 found that the positive and negative dimensions of explicit attitudes together accounted for a significant proportion of the variance in subsequently measured, objective speeding behaviour on a driving simulator. However, the positive dimension was found to independently predict speeding behaviour whereas the negative dimension did not. It was also found in study 1 that the positive and negative dimensions of implicit attitudes together accounted for a significant increment to explained variance in subsequently measured objective speeding behaviour, over and above the variance that was accounted for by the positive and negative dimensions of explicit attitudes. The positive dimension of implicit attitude was found to be a significantly stronger independent predictor of speeding behaviour than was the negative dimension, demonstrating, for the first time, that the positivity bias found with explicit bi-dimensional attitude-behaviour relationships can generalise to implicit bi-dimensional attitude-behaviour relationships. The implication was that speeding behaviour is dictated by evaluations of positive behavioural outcomes at the expense of the negative behavioural outcomes at both the explicit level of cognitive functioning (i.e. when an individual has the motivation and opportunity to think about what action to take,) and the implicit level (i.e., when behaviour is more reactive or automatic). It was concluded that this finding suggests that attitude-change interventions should focus on both explicit and implicit attitudes and primarily the positive dimension of both types of attitude. This informed the development of the induced compliance (attitude-change) intervention in study 2.

In addition, the research presented in Chapter 4 concluded that the methods used to measure both explicit and implicit bi-dimensional attitudes in study 1 were psychometrically reliable, valid, and suitable for use in the subsequently presented studies to test intervention effectiveness. Also, the objective (driving simulator) behaviour measure was deemed suitable for use in the subsequent studies. Therefore, the measures developed in study 1 were used to test intervention effectiveness in studies 2 and 3.

Chapter 5 presented the second study in this programme of research. The purpose of Study 2 was to develop and test an induced compliance intervention with a view to inducing cognitive dissonance and thereby change the positive dimensions of drivers' explicit and implicit attitudes towards speeding (on the basis of study 1 showing that the positive dimensions of both explicit and implicit attitudes were the sole predictors of speeding) and reduce their subsequent speeding behaviour. Immediately after intervention delivery, the participants randomised to the experimental condition reported significantly greater levels of cognitive dissonance than did the participants randomised to the control condition. They also reported significantly less positive explicit attitudes towards exceeding the speed limit immediately following the intervention and one-month later. As expected, the effect on attitudes was confined to the positive attitude dimension; no difference between the experimental and control condition was found on the negative dimension of attitude. No difference between the conditions was found in implicit attitudes. Although no difference between conditions was found for objective (driving simulator) speeding behaviour at immediate post-intervention, the experimental participants reported that they had exceeded the speed limit significantly less often over the month following intervention delivery. Additionally, while self-reported cognitive dissonance did not mediate the observed attitude-change at either immediate or one-month post-intervention, attitude-change at both immediate and one-month post-intervention mediated the observed one-month post-intervention behaviour-change.

Chapter 6 presented the third study in this programme of research. The purpose of Study 3 was to test a hypocrisy induction intervention that was designed to induce cognitive dissonance and thereby reduce drivers' speeding behaviour, by bringing it in line with their generally desirable attitudes, which were against the act of speeding. Immediately after intervention delivery, the participants randomised to the experimental condition did not report significantly greater levels of cognitive dissonance than did the participants randomised to the control conditions. Furthermore, the participants randomised to the experimental condition were not found to exceed the speed limit significantly less frequently at either immediate post-intention (on the driving simulator), or one-month later (through self-reported speeding) than were the participants randomised to the first control condition, in which a task was employed that contained the same elements as the hypocrisy induction intervention but designed to prevent the induction of cognitive dissonance. However, the participants randomised to the experimental condition were found to exceed the speed limit significantly less frequently at both immediate and one-month post-intervention than were the participants randomised to the second control condition, in which the participants received a standard road safety educational intervention.

7.4 Implications and future directions

7.4.1 Theory

The finding that cognitive dissonance inducing interventions led to attitude- (study 2) and behaviour- (studies 2 and 3) change is consistent with the theoretical tenets of the two key paradigms within the cognitive dissonance literature. More specifically, the finding that both immediate and longer term attitude-change (study

2) can be found from encouraging people to behave in a way that is not consistent with their stated attitudes is consistent with the induced compliance paradigm (e.g., Festinger & Carlsmith, 1959). Furthermore, the finding that the attitude-change generated behaviour-change one month later is consistent with the theoretical tenets of the attitude-behaviour models reviewed in chapter 2, which prescribe a causal path from attitudes to behaviour (e.g., theory of planned behaviour; Ajzen, 1985). Similarly, the finding that both immediate and longer term behaviour-change, in the absence of attitude-change (study 3), can be generated from encouraging people to reflect on the times when their behaviour contravened their existing attitudes is consistent with the hypocrisy induction paradigm (e.g., Aronson et al, 1991). The findings do not support the causal mechanism, however, that is theoretically proposed to underpin these observed effects (i.e., cognitive dissonance induction) because cognitive dissonance was not found to mediate attitude- or behaviour-change in any of the studies.

As discussed in chapter 5, other possible explanations for the attitude-change found in study 2 were the theoretical process of self-perception and persuasion. With regard to self-perception, Bem (1967; 1972) maintained that people do not have insight into their own attitudes and so they determine their attitudes based on how they have behaved. In study 2, the induced compliance intervention required the participants to argue, contrary to their existing attitudes at the time, that speeding was not a positive behaviour. They did this by generating arguments countering their existing reasons for viewing speeding as a positive behaviour. In doing this, the participants may have perceived through the cognitive process of self-perception that their attitudes were different (less positive) than they were previously, thus explaining the observed shifts in attitudes. With regard to the process of persuasion (e.g., Petty & Cacioppo, 1979) it was argued that the self-generation of persuasive messages may have produced a powerful persuasion effect. It is known from the literature on persuasion (e.g., Hovland et al., 1953) that attitude-change is more likely when the source of a persuasive message is credible and the audience can comprehend and accept the message. In the study 2, the participants were effectively both the source of the messages that were developed and the audience. To avoid a threat to their own self-integrity (e.g., Steele, 1988) they would be unlikely to view themselves as non-credible sources. Similarly, since the participants developed their own messages they would be likely to comprehend and perhaps accept them to a greater extent than they would a message delivered to them (e.g., through a passive intervention such as a road safety leaflet).

It was also proposed that it was also possible that cognitive dissonance was responsible for the changes in attitudes that were observed in study 2 but the self-reported measure of cognitive dissonance that was used was not sufficient for detecting the effect. Cognitive dissonance was measured using the dissonance thermometer. Although this is an established tool, and an intervention effect on the measure of cognitive dissonance that it produces was found in this study, previous experimental studies have often failed to find that effect (e.g., Chait, 2010; Simmons et al., 2004). It was argued to be possible, therefore, that the measure is not a particularly sensitive one for detecting the magnitude of cognitive dissonance induction taking place when an induced compliance intervention, such as the one developed in study 2, is delivered. Physiological measures of arousal (e.g., galvanic skin responses) can be used to indicate emotional reactivity (e.g., Croyle & Cooper, 1983; Elkin & Leippe, 1986; Losch & Cacioppo, 1990) and may therefore provide more sensitive measures of cognitive dissonance than self-reports. Such measures may indicate a greater magnitude of dissonance induction, which has greater scope to be found to mediate attitude-change in experimental research such as this. Future research is, therefore, needed to determine the theoretical mechanisms underpinning attitude-change following the delivery of an induced compliance intervention. Further research might usefully test self-perception, persuasion and physiologically measured cognitive dissonance as mediators of attitude-change.

However, not all of the possible explanations for attitude-change indicated above can explain the behaviour-change found in study 3. For example, self-perception theory argues that individuals determine their attitudes based on how they have behaved. In the hypocrisy induction intervention, the participants were made aware of their desirable attitudes towards speeding, in the attitude-saliency sub-task, and were also asked to recall past instances when they exceeded the speed limit, in the mindfulness sub-task. In line with self-perception theory, the participant would be expected to change their attitudes to be in line with their behaviour. However, participants did not change their attitudes following this task. Instead, they changed their behaviour, meaning that the findings were not consistent with self-perception theory. In addition, persuasion cannot explain the findings in study 3 as the hypocrisy induction intervention was not designed to change attitudes, as the drivers in this study already had pre-existing negative (safe) attitudes towards speeding. Therefore the participants did not need persuading that they should not exceed the speed limit, rather, they needed help converting their attitudes into safe behaviour.

It is possible, however, that cognitive dissonance was responsible for the changes in behaviour that were observed in study 3 but the self-reported measure of cognitive dissonance that was used was not sufficient for detecting the effect. For example, the observed reductions in immediate and one-month post-intervention speeding behaviour in study 3 in the experimental condition was only found relative to the second control condition (standard road safety education), not relative to the first control condition. It was reasoned that the tasks in these two conditions may have been too similar and triggered the same underlying psychological processes that engendered equivalent behaviour-change. One possibility that was considered was that the tasks employed in each condition altered behaviour to an equivalent extent, not through an affective process (e.g., the experience of cognitive dissonance) but an instrumental process. However, another possibility that was considered was that the participants in both conditions experienced cognitive dissonance that was undetected by the self-reported dissonance measure that was employed, with the dissonance induction occurring in the experimental condition through mindfulness of counter-attitudinal behaviour (i.e., consistent with the hypocrisy induction paradigm) and the first control condition through spontaneous thought-priming of counter-attitudinal behaviour (e.g., A. Clarke et al., 1999). It is reasonable to argue, therefore, that this explanation is the most likely in the context of this research as it is the only explanation can explain the findings in both studies 2 and 3. That said, it is possible that each intervention may have been effective due to different underlying mechanisms. Therefore, future research testing the effect of both the induced compliance and hypocrisy induction interventions on physiologically measured cognitive dissonance (e.g., Croyle & Cooper, 1983; Elkin & Leippe, 1986; Losch &

Cacioppo, 1990) is needed to help reach a conclusion about whether these interventions can induce cognitive dissonance and whether that dissonance induction can mediate the subsequent attitude or behaviour-change.

7.4.2 Methodology

To be able to test the effectiveness of the attitude-change (e.g., induced compliance) and attitude-conversion (e.g., hypocrisy induction) interventions reported in this thesis, there was a need to develop and test key measures of attitudes. Measures of explicit and implicit bi-dimensional attitudes were developed in study 1 (chapter 4) and tested for validity and reliability. The explicit bi-dimensional attitudes were measured using standard questionnaire items (i.e., commonly employed in the literature and shown to produce reliable measures) and the measures were found to be psychometrically reliable and valid and were therefore deemed suitable for use in the subsequently presented studies. In addition, two single-attribute IATs were developed to measure implicit bi-dimensional attitudes. Specifically, although IATs had been used in previous research to measure unidimensional attitudes, single attribute IATs had not previously been used to measure bi-dimensional attitudes. The implicit bi-dimensional attitude measures that were developed were found to be psychometrically reliable and valid and therefore suitable for use in the subsequently presented studies. This, overall, supports the utility of the measures of explicit and implicit bi-dimensional attitudes that were developed in this programme of research. These measures could be usefully employed in future research that aims to test effects of interventions designed to change these types of attitudes or their potential effects on behaviour.

There was also a need to develop and test a measure of objective speeding behaviour. A measure of objective speeding behaviour was also developed in study 1. The measure was deemed suitable for use in the subsequently presented studies as the simulator used had been shown to generate measures of speeding behaviour that significantly correlate with self-reported measures of real-world speeding. In addition, constructs that typically predict speeding in the real world (e.g., age, driving experience, behavioural intentions, perceived behavioural control, and moral norm) also predict speeding on the driving simulator using in this programme of research. Furthermore, the mean driving speed reported in chapter 4 was comparable to the mean speed on 30mph speed limit roads in the UK. It was argued that the findings reported in chapter 4, therefore, support those from validation studies of driving simulators more generally, which have shown that the results from driving simulator experiments are the same as those from real-world studies of driving (e.g., Helman & Reed, 2015). This, overall, supports the utility of future research using driving simulators to obtain objective measures speeding behaviour.

The dissonance thermometer was used to measure cognitive dissonance in studies 2 and 3. However this measure was not found to mediate the attitude-change in study 2 or the behaviour-change in study 3. Although the dissonance thermometer is an established tool, it is possible that the measure is not a particularly sensitive one for detecting the magnitude of cognitive dissonance induction taking place when an induced compliance intervention, such as the one developed in this thesis, is delivered. It was discussed in chapter 5 that physiological measures of arousal (e.g., galvanic skin responses) can be used to indicate emotional reactivity (e.g., Croyle & Cooper, 1983; Elkin & Leippe, 1986; Losch & Cacioppo, 1990) and may therefore provide more sensitive measures of cognitive dissonance. It was argued that such measures may indicate a greater magnitude of dissonance induction, which has greater scope to be found to mediate attitude-change in experimental research such as this.

On reflection, the dissonance thermometer may not be able appropriate for detecting cognitive dissonance within intervention research, such as reported in this thesis. For example, within the hypocrisy induction paradigm, participants may resolve any feelings of cognitive dissonance when they are completing the intervention tasks (e.g., they may feel cognitive dissonance during the task but make a conscious decision to intend to avoid speeding in the future, which may reduce any feelings of cognitive dissonance). Thus, when participants are subsequently asked to complete the dissonance thermometer, they are no longer feeling dissonance. Further research using physiological measures when testing cognitive dissonance interventions is therefore recommended to aid conclusions about whether these interventions can successfully induce cognitive dissonance.

7.4.3 Road safety

The findings from the programme of research presented in this thesis tend to support the utility of both induced compliance and hypocrisy induction interventions for reducing speeding behaviour, relative to current practice (standard road safety education). The findings therefore imply that these interventions could be usefully implemented in the field with induced compliance interventions being used to help improve the behaviour of drivers who regularly speed in line with their positive (generally unsafe) attitudes towards this behaviour (i.e., attitude-change required) and hypocrisy induction interventions being used to help improve the behaviour of drivers who speed in spite of their pre-existing negative (generally safe) attitudes towards this behaviour (i.e., attitude conversion required). Those reductions in speeding can in turn be expected to generate benefits to society in terms of reduced traffic crashes. Specifically, a reduction in traffic crashes would be expected to reduce the associate costs and burden on the economy and health services (see chapter 1). In addition, a reduction in speeding may also lead to a reduction in harmful gas emissions, which is beneficial for the environment. This in turn would be a benefit to society as it would be expected to reduce health problems associated with poor air quality (see chapter 1).

With regards to possible routes to implementation, the interventions developed in this PhD programme would be amendable to being incorporated into existing driver training courses (e.g., Brijs et al., 2014; Elliott & Armitage, 2009), most notably speed awareness courses (McKenna, 2003; Stephenson, Wicks, Elliott, & Thomson, 2010). Speed awareness courses currently operate in England and Wales, and they provide an educational alternative to penalty points for drivers caught by the police or safety cameras for exceeding the speed limit by up to 10%+2 to 6mph, depending on the enforcement region. There are also plans to introduce such courses in Scotland in the near future (Grant, 2019). Although, there is limited evidence from controlled experiments showing that these courses can change attitudes or behaviour (e.g., McKenna, 2003; Stephenson et al., 2010), and they typically employ traditional methods of persuasion in order to change attitudes in class room-based settings. As mentioned in this thesis, these methods, which are heavily reliant on the passive transmission of second-hand information about the risks of speeding, are unlikely to generate strong attitudes that have the scope to change behaviour (see chapter 2). Instead, the interventions developed in this programme of PhD research require active engagement from individuals and promising evidence has been collected for their effectiveness and changing attitudes and behaviour from randomised controlled experiments. Also, the implicit assumption within educational interventions such as speed awareness courses is that all drivers require attitude-change, whereas many drivers do not. Instead, they require attitude-conversion (see chapter 2). The interventions developed in this PhD programme might therefore usefully enhance the ability of speed awareness courses to engender reductions in speeding. Future research testing the effects of ‘standard’ course delivery versus standard delivery plus cognitive dissonance-based interventions on drivers’ speeding behaviour would be useful for gauging the additional benefit of the present interventions over and above existing speed awareness courses.

It is acknowledged that the delivery of the interventions developed in this PhD programme of research is resource intensive (i.e., they require a ‘trainer’ to deliver the intervention). While this is possible in driver training courses which seek to modify attitudes and speeding behaviour, such courses do not have as much reach as other methods of driver education (e.g., publicity campaigns; Department for Transport, 2013b). Therefore, future research might usefully explore how the present interventions can be modified to allow them to be delivered to larger sections of the driving population. In particular, consideration should be given to automating the interventions (e.g., through web-based platforms or mobile phone apps). Such interventions are now becoming relatively commonplace for improving a variety of health behaviours (e.g., Burke-Garcia & Scally, 2014; Schwarzer et al., 2018). They are low-cost in terms of delivery, easily accessible through internet-connected devices, and therefore amenable to reaching large sections of the population in order to help bring about larger scales changes in behaviour. Further research would need to be carried out to test the effectiveness of such delivery mechanisms to ensure the present interventions are still capable of generating changes in attitudes and behaviour.

7.5 Key methodological considerations

Several methodological considerations of the studies reported in this thesis have already been discussed in the previous chapters. The key ones, which span across the studies and have a bearing on the conclusions for the effects of the cognitive dissonance interventions, are the length of the follow-up periods that were employed in studies 2 (induced compliance intervention) and 3 (hypocrisy induction intervention) and the use of predominantly student samples. As discussed in the previous two chapters, the effects of both the induced compliance and hypocrisy induction interventions were tested over a one-month period. The issue of whether the interventions would have longer lasting effects was considered. It was reasoned that although there would be value in testing the potential longer-term effects of the induced compliance and hypocrisy induction interventions, previous research has shown that behaviour change observed after one month tends to persist (e.g., Armitage, 2005). In addition, studies of cognitive dissonance interventions have reported sustained effects 3 years post-intervention (e.g., Stice et al, 2008), which suggests that the effects of these interventions may also persist over time. It was therefore concluded that there is good reason to assume that the observed effects of the interventions tested in this research would also persist.

As also discussed in the previous two chapters, the samples used in this research comprised largely of university students and samples comprising university students are often criticised on the presumption that students may be more compliant with task demands (e.g., Jackson et al., 2005). This potentially increases the risk that studies using predominantly student samples will be biased towards the confirmation of study hypotheses (e.g., Jackson et al., 2005). However, it was argued that the findings are still held with confidence, most notably because previous intervention studies have demonstrated similar effect sizes across student and non-student samples (e.g., Gollwitzer & Sheeran, 2006b) and randomised controlled designs were used to test the interventions that were developed in this PhD. Thus, any susceptibility to experimenter demand would have been equalised across the experimental and control conditions and yet evidence was still found for attitude-change (following the induced compliance intervention, as expected) and behaviour-change (both following the induced compliance and hypocrisy induction interventions).

A final methodological consideration that should be taken into account is the nature of the behaviour measures. A driving simulator was employed in all studies to collect the objective measures of behaviour. As discussed in chapter 4 (study 1), objective measures of behaviour obtained from naturalistic settings in the real world (e.g., black box technology to measure driving speeds in everyday driving) are often regarded as gold standard in road safety research (e.g., Carsten et al., 2013). However, they are problematic for testing road safety countermeasures such as induced compliance and hypocrisy induction interventions because the purpose of these interventions is to prevent the occurrence of the problem behaviour (e.g., speeding) when people have the opportunity to perform it and it is not possible to control for opportunity in naturalistic settings in the real world (e.g., road, traffic and weather conditions can put undue constraints upon driver behaviour, removing the opportunity to speed in many circumstances, which will, in turn, make it difficult to detect genuine intervention effects). Furthermore, as discussed in chapter 4, the constraints upon behaviour from naturalistic, real-world settings are not possible to equalise across participants, meaning that real-world data are extremely noisy, which again undermines a study's ability to detect genuine intervention effects (e.g., Kaptein et al., 1996). For these reasons, a driving simulator was deemed appropriate in this research programme because it allows objective behaviour measures to be collected under experimentally controlled conditions, where all participants can be, and were, exposed to the same stimuli.

Although measures of behaviour from driving simulators have previously been criticised for potentially lacking ecological validity (e.g., Neale & Leibert, 1986), it was noted in chapter 4 that the simulator used in this programme of research has been shown to generate measures of speeding behaviour that significantly correlate with self-reported measures of real-world speeding (McCartan & Elliott, 2018) and there is evidence that the constructs that typically predict speeding in the real world (e.g., age, driving experience, behavioural intentions, perceived behavioural control and moral norm) also predict speeding on this driving simulator (Brewster et al., 2016). Furthermore, as shown in study 1, and discussed above, the mean driving speed of participants on driving simulator route that was used in all studies in this programme of research was comparable to the mean speeds that are observed on roads in the UK – information that is readily available from official statistics (Department for Transport, 2018c) and reported in chapter 4. This supports the findings from validation studies of driving simulators more generally (e.g., Helman & Reed, 2015; Lockwood, 1997).

The self-reported measures of behaviour that were employed in studies 2 and 3 to test the one-month post-intervention effects have also been discussed in the previous chapters. In summary, it is acknowledged that self-reported behaviour measures are often considered to be potentially vulnerable to cognitive (Murdock, 1962), affective (Mayer et al., 1995) and self-presentational (Gur & Sackeim, 1979; Paulhus & Reid, 1991) biases, hence the reason for employing a driving simulator in this research. However, as also discussed in previous chapters, it was not deemed feasible to collect the one-month post-intervention measures of speeding using the driving simulator without unduly affecting the attrition rate so self-reports were employed. Nevertheless, the self-reported measure employed in the intervention studies was a previously developed tool that is known to possess good internal reliability (which was also the case in both intervention studies reported in this thesis) and had previously been used to successfully test road safety interventions (e.g., Brewster et al., 2015; Brewster et al., 2016). In addition, despite objective behaviour measures being preferable, self-reports are known to be highly corrected with objective estimates of driving speed (e.g., Åberg, Larsen, Glad, & Beilinsson, 1997; de Waard & Rooijers, 1994). Overall, therefore, and in conjunction with the use of the objective behaviour measures employed in this research to assess immediate post-intervention changes in driver behaviour, the findings are held with confidence.

7.6 Contribution to knowledge and final conclusions

The research reported in this thesis was the first in which an induced compliance (attitude-change) intervention had been developed to change drivers' attitudes towards speeding and their subsequent speeding behaviour. Furthermore, a hypocrisy induction intervention had been developed to reduce speeding in just one previous study and that study did not test the efficacy of that intervention to reduce speeding behaviour (Fointiat, 2008). The findings of this thesis therefore demonstrate, for the first time, that the induced compliance and hypocrisy induction intervention techniques might be effective at reducing drivers' speeding behaviour.

With regards to induced compliance interventions specifically, the findings demonstrate that changes in the key attitudes that underpin speeding, namely the positive dimensions of explicit attitudes, can be generated and, in doing so, changes in behaviour can be achieved. These findings are important, not only because they support the use of induced compliance as a behaviour-change technique in a new context, but also because they are consistent with the causal direction between attitudes and behaviour (i.e., attitudes → behaviour) that is proposed by many models in the literature. The findings are particularly encouraging because previous road safety educational (attitude-change) interventions tend to rely on stressing the risks of speeding, which is likely to target the negative dimension of attitude (i.e., encouraging drivers to increase the extent to which they perceive the negative attributes of speeding as being negative). Given that the negative attitude dimension is known to be a poor predictor of behaviour, this is a possible explanation for why previous interventions have been largely ineffective at reducing speeding. On the other hand, the positive attitude dimension is a reliable predictor of speeding and therefore is likely to have greater potential to change behaviour, consistent with the findings of this research.

In addition, the findings of this thesis contribute to the literature by demonstrating that hypocrisy induction interventions can be effective at reducing speeding behaviour through the process of attitude-conversion (in this context, helping drivers' convert existing, desirable attitudes towards speeding into safe driving). This again is encouraging and extends the existing literature because virtually all educational interventions that are tested in psychology and implemented in the field (both within the context driving and more generally) focus on attitude-change, which is not needed for many drivers (i.e., those who have socially desirable attitudes but simply fail to enact them). Interventions such as the hypocrisy induction intervention developed in this PhD programme are therefore needed to supplement attitude-change interventions.

Despite cognitive dissonance not being found to explain the observed attitude and behaviour changes in the present research, the findings support the enhanced utility of both induced compliance and hypocrisy induction interventions for changing behaviour more generally, relative to current practice, in this case standard road safety education. This is important because standard educational materials have not been demonstrated convincingly to have a strong impact on behaviour-change in the context of driving (see chapter 2) or in other health contexts (e.g., Hardeman et al, 2002) This thesis, therefore, has contributed to the understanding of the literature on the theory of cognitive dissonance, the attitude-behaviour relationship, and the understanding of effective methods which can be used reduce speeding behaviour. The evidence suggests that both interventions developed in this programme of PhD research could be expected to reduce the drivers' speeding behaviour and its detrimental effects on road safety, the economy and health and wellbeing. Future work is needed to establish the theoretical underpinnings of the interventions (i.e., whether the interventions can change attitudes or behaviour through cognitive dissonance or some other mechanism) and potentially to ensure the longer term (post-one month) effects of the intervention on objectively measured behaviour.

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Appendix A: Participant information sheet for Study 1

Participant Information Sheet

Name of school: School of Psychological Sciences and Health
Title of the study: Attitudes towards driving

Introduction
[Researcher names] are members of a research team examining the relationship between driver behaviour and attitudes towards driving.

What is the purpose of this investigation?
This study is being conducted to further our understanding of driver behaviour. You may participate in this study if you are aged 18 years old or older, and you hold a full UK driving licence and drive at least once a week.

Do you have to take part?
No. Participation is entirely voluntary and you have the right to withdraw from the study at any time without having to give a reason. If you are a university student this will not affect any of the services you receive from the university.

What will you do in the project?
If you choose to participate in this study, you will be invited to the School of Psychological Sciences and Health situated in the Graham Hills Building of the University of Strathclyde. You will be asked to complete a short questionnaire that will ask you about your driving and speeding behaviour. The questionnaire will take approximately 5 minutes to complete. We recognise that attitudes vary greatly between people and are held for many different and valid reasons. Therefore, we are simply interested in obtaining your honest answers to the questions. Following completion of the questionnaire, you will be asked to complete a categorisation task relating to driving. In these tasks, you will see words such as ‘happy’ or ‘evil’ and you must press a particular key on a computer as quickly as you can depending on whether that word matches a category label that appears on the screen (e.g., ‘good’ or ‘bad’). Detailed instructions will be given prior to the task starting. The categorisation tasks will take approximately 15 to complete. You will then be asked for your email address so we can contact you regarding your participation in the follow up session two weeks later. The follow-up session will involve the following:

- You will be invited to the University of Strathclyde Driving Research Laboratory situated in the Graham Hills Building to complete a second questionnaire, taking approximately 5 minutes to complete, and to drive on a driving simulator for approximately 15 minutes.

What are the potential risks to you in taking part?
There is a risk of developing feelings of sickness whilst driving on the simulator. However, simulator sickness is rare and any feelings of sickness disappear very quickly after people

stop driving. If you are prone to experiencing motion sickness (e.g. feelings of nausea when in a car or boat) then you may be affected (but not necessarily). If you take part and you start to feel sick on the simulator, you should tell the researcher immediately and the trial will be stopped.

What happens to the information in the project?
The information recorded in this study will remain confidential during data collection. This means that your data from all participation sessions will be given a unique code. This will allow us to match the information you provide for each experimental tasks (e.g., we will match the information you provide from each questionnaire with your responses in the categorisation tasks). As mentioned above, you will also be asked for your email address so we can contact you regarding your participation in the follow up session. The unique codes and email addresses for all participants will be recorded on a secure database accessibly by only the named researchers. After the data from all experimental sessions are matched and entered into an electronic database, your email address will be deleted from the system and your data will be anonymous. Once this happens, you will no longer be able to withdraw your data. The information you provide will be pooled with the information provided by the other participants and analysed in order to develop an overall picture of people's attitudes and behaviour within the context of driving. The information collected in this project will be stored in a database that can be accessed only by the named researchers. The anonymised data obtained in this project will be retained indefinitely.

Thank you for reading this information – please ask any questions if you are unsure about what is written here.

What happens next?

If you are happy to participate in the project, you will be asked to sign a consent form to confirm this. If you do not want to be involved in the project then thank you for your attention.

Researcher Contact Details:
[Researcher information]

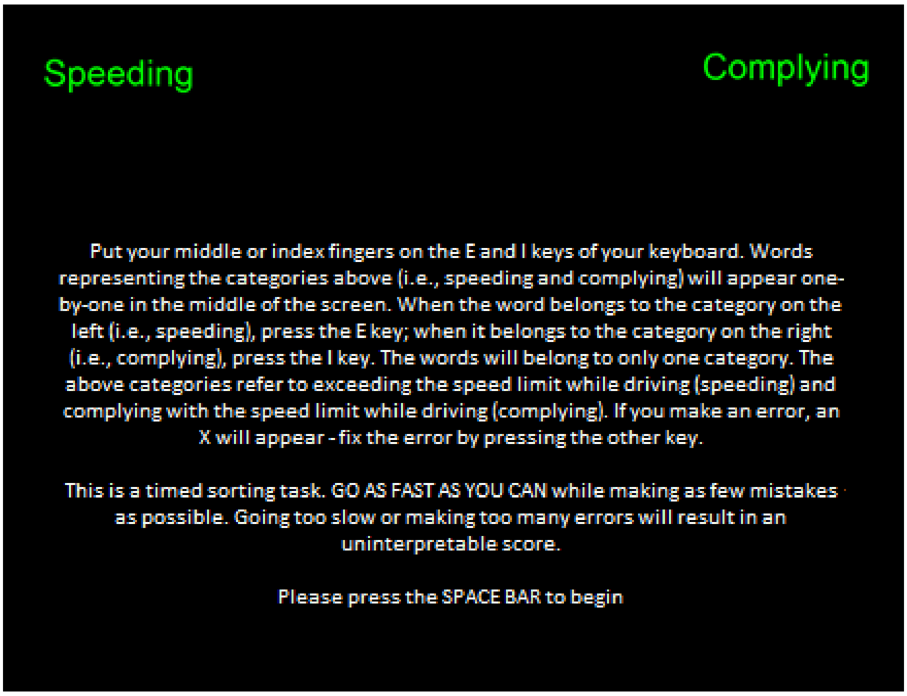
Chief Investigator Details:
[Chief investigator information]

This investigation was granted ethical approval by the School of Psychological Sciences and Health ethics committee.
If you have any questions/concerns, during or after the investigation, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact:

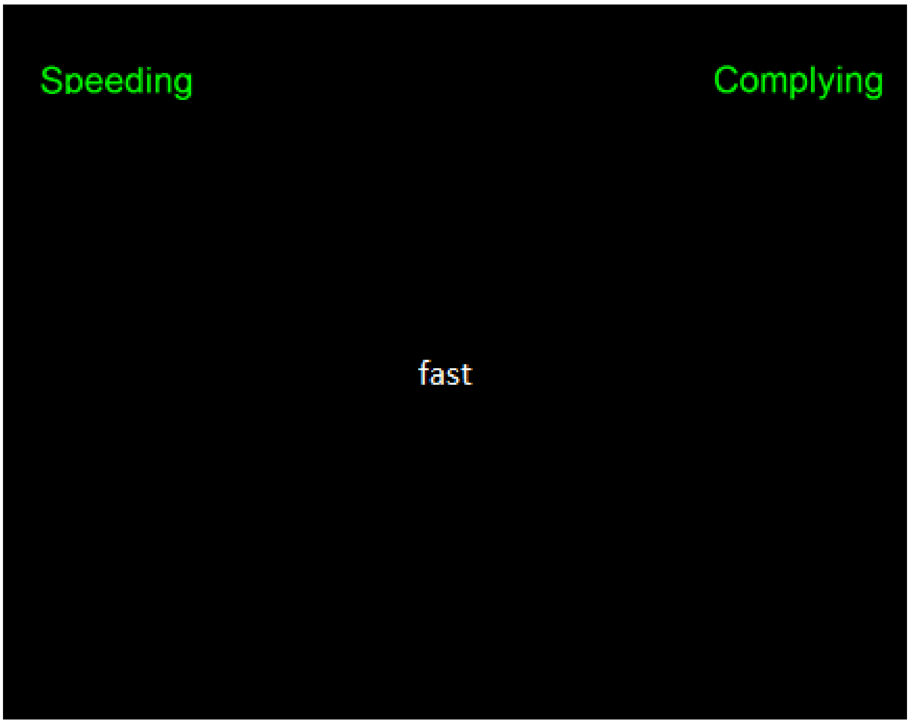
[Convener of the Ethics Committee information]

Appendix B: IAT Example: Version 1 of the IAT measuring the positive dimension of implicit attitudes

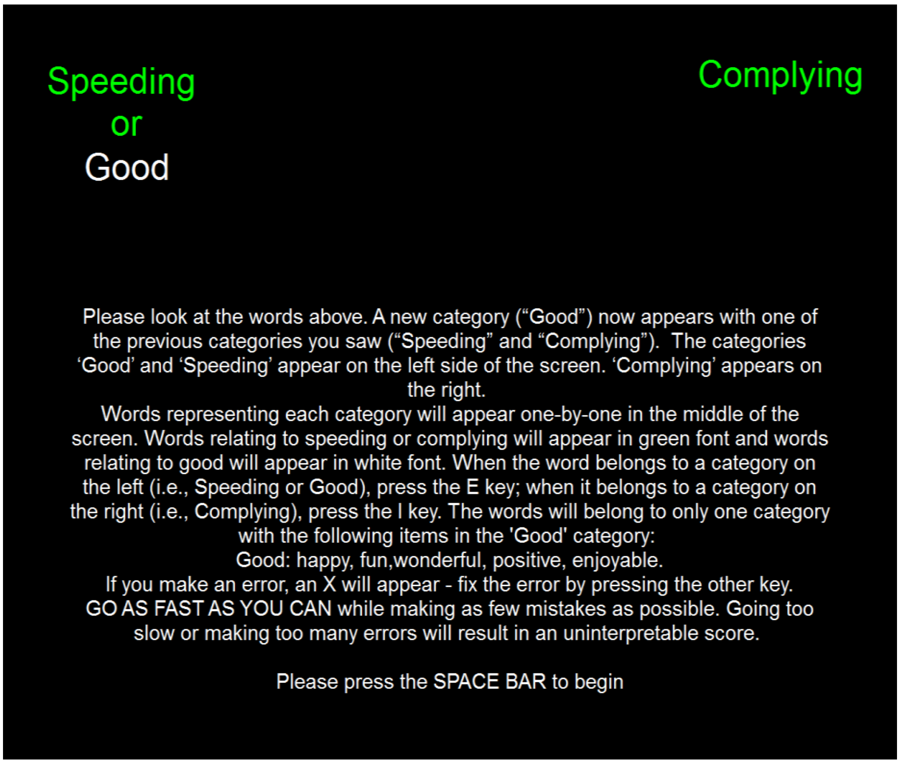
Block 1 Introduction:



Block 1 task:

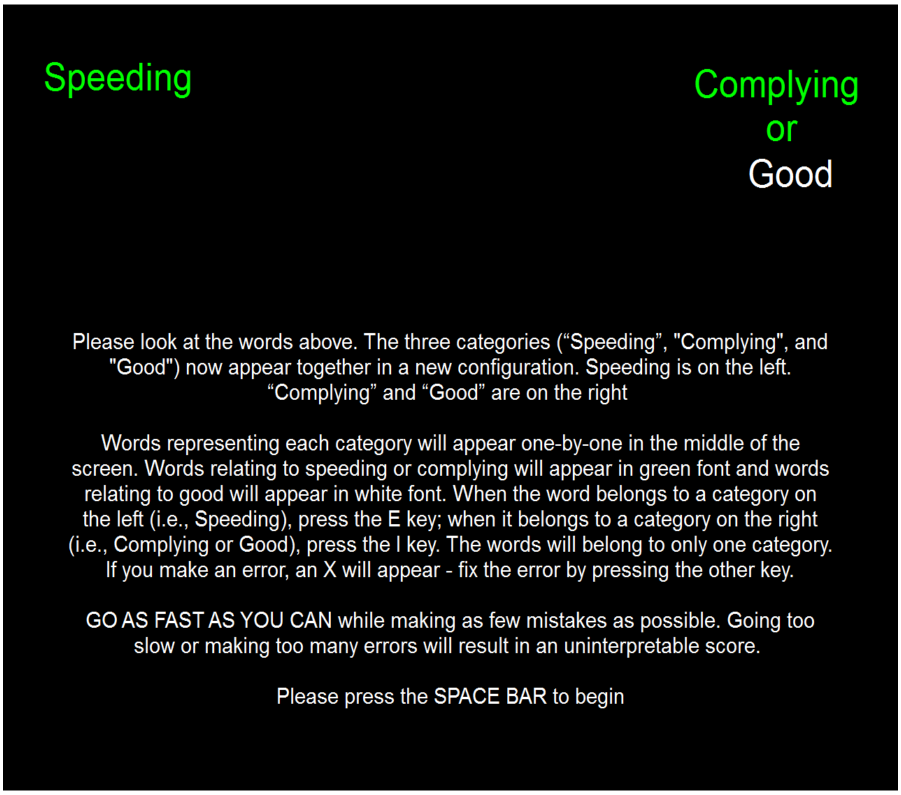


Block 2 introduction:



Block 2 and 3 task:

Block 4 introduction:



Block 4 and 5 task:

Appendix C: Driving Simulator image

Appendix D: Participant information sheet for Study 2 and 3

Participant Information Sheet

Name of school: School of Psychological Sciences and Health
Title of the study: Driver behaviour and attitudes

Introduction
[Researcher names] are members of a research team examining driver behaviour and attitudes.

What is the purpose of this investigation?
This study is being conducted to further our understanding of driver behaviour and the attitudes that drivers have towards speeding. You may participate in this study if you are aged 18 years old or older, and you hold a full UK driving licence and drive at least once a week.

Do you have to take part?
No. Participation is entirely voluntary and you have the right to withdraw from the study at any time without having to give a reason. If you are a Strathclyde University student this will not affect any of the services you receive from the university.

What will you do in the project?
If you choose to participate in this study, you will be asked to complete a short online questionnaire measuring your driving habits and attitudes, taking approximately 5 minutes to complete. We recognise that attitudes vary greatly between people and are held for many different and valid reasons. Therefore, we are simply interested in obtaining your honest answers to the questions. You will then be asked for your email address so we can contact you if you are selected to take part in the study. If you are selected, you will be invited to the School of Psychological Sciences and Health situated in the Graham Hills Building of the University of Strathclyde. You will be asked to complete a series of tasks, taking approximately 30 minutes to complete. Additional details about these tasks will be provided at your participation session. You will also be asked to complete another online questionnaire taking approximately 10 minutes to complete, as well as being asked to drive on the university's driving simulator for approximately 10 minutes. One month later, you will be asked to complete another short online questionnaire measuring your driving habits and attitudes, taking approximately 5 minutes to complete.

What are the potential risks to you in taking part?
There is a risk of developing feelings of sickness whilst driving on the simulator. However, simulator sickness is rare and any feelings of sickness disappear very quickly after people stop driving. If you are prone to experiencing motion sickness (e.g. feelings of nausea when in a car or boat) then you may be affected (but not necessarily). If you take part and you start to feel sick on the simulator, you should tell the researcher immediately and the trial will be stopped.

What happens to the information in the project?
The information recorded in this study will remain confidential during data collection. This means that your data from all participation sessions will be given a unique code. This will allow us to match the information you provide for each experimental task (e.g., we will match the information you provide from each questionnaire with your responses in the computer tasks and driving simulator). As mentioned above, you will also be asked for your email address so we can contact you regarding your participation in the study. The unique codes and email addresses for all participants will be recorded on a secure database accessibly by only the named researchers. After the data from all experimental sessions are matched and entered into an electronic database, your email address will be deleted from the system and your data will be anonymous. Once this happens, you will no longer be able to withdraw your data. The information you provide will be pooled with the information provided by the other participants and analysed in order to develop an overall picture of drivers' attitudes and behaviour. The information collected in this project will be stored in a database that can be accessed only by the named researchers. The anonymised data obtained in this project will be retained indefinitely.

Thank you for reading this information – please ask any questions if you are unsure about what is written here.

What happens next?

If you are happy to participate in the project, you will be asked to sign a consent form to confirm this. If you do not want to be involved in the project then thank you for your attention.

Researcher Contact Details:
[Researcher information]

Chief Investigator Details:
[Chief investigator information]

This investigation was granted ethical approval by the School of Psychological Sciences and Health ethics committee.
If you have any questions/concerns, during or after the investigation, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact:

[Convener of the Ethics Committee information]

Appendix E: Cognitive Dissonance Measure: Dissonance Thermometer

Dissonance Thermometer (Elliot & Devine, 1994)

This measure instructs participants to “please indicate how you are feeling right now”. The participants are shown 15 item and asked to respond to each item on a 9-point scale from “Does not apply at all” (scored 1) to “Applies very much” (scored 9).

The Dissonance Thermometer includes 4 subscale: positive affect, negative self-affect, shame, and discomfort. The discomfort items are used to measure dissonance.

The 15 items are:

1) Happy
2) Angry at myself
3) Shame
4) Uneasy
5) Friendly
6) Disgusted with myself
7) Embarrassed
8) Bothered
9) Optimistic
10) Annoyed at myself
11) Disappointed with myself
12) Guilty
13) Energetic
14) Uncomfortable
15) Good

Items 4, 8 and 14: emotions relating to discomfort.
Items 2, 6, 10 and 11: negative self-index
Items 3, 7 and 12: shame index
Items 1, 5, 9, 13 and 15 positive affect index