Can enforced behaviour change attitudes: Exploring the influence of Intelligent Speed Adaptation

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A B S T R A C T

The Theory of Planned Behaviour model (Ajzen, 1985) was used to determine whether long-term experience with Intelligent Speed Adaption (ISA) prompts a change in speed related cognitions. The study examines data collected as part of a project examining driver behaviour with an intervening but overridable ISA system. Data was collected in four six-month field trials. The trials followed an A-B-A design (28 days driving with no ISA, 112 days driving with ISA, 28 days driving without ISA) to monitor changes in speeding behaviour as a result of the ISA system and any carry-over effect of the system. Findings suggested that following experience with the system, drivers’ intention to speed significantly weakened, beyond the removal of ISA support. Drivers were also less likely to believe that exceeding the speed would ‘get them to their destination more quickly’ and less likely to believe that ‘being in a hurry’ would facilitate speeding. However, the positive change in intentions and beliefs failed to translate into behaviour. Experience with the ISA system significantly reduced the percentage of distance travelled whilst exceeding the speed limit but this effect was not evident when the ISA support was removed.

1. Introduction

Travelling at excessive or inappropriate speeds is not only endemic, but one of the largest single contributory factors in road traffic accidents in the U.K. (Carsten et al., 1989; Mosedale and Purdy, 2004; Robinson and Campbell, 2006). In recognition that alternative and novel remedial measures may be required if significant improvements in road safety are to be achieved via reducing speed, there is now growing world-wide interest in the potential of intelligent transport systems.

Intelligent Speed Adaptation (ISA) is a general term for intelligent transport systems that serve to limit the speed of a vehicle. The least intrusive forms of ISA provide continual speed limit information to the driver but there is no link to vehicle control. At the other end of the scale, an ISA system can interfere with the vehicle control, permanently limiting the speed of the vehicle to that of the posted speed limit. Unsurprisingly, the latter form of ISA offers the greatest potential to modify behaviour, however, changes in speeds have also been noted with systems which exert no control over the vehicle (e.g., Carsten et al., 2001), which could imply that the observed behavioural changes are caused by underlying changes in cognitions.

Despite the wealth of literature documenting the behavioural impact of ISA systems, few studies have examined the effect of ISA upon cognitions relating to speeding, concentrating instead on drivers’ attitudes towards the ISA system itself. Nevertheless, it seems reasonable to suppose that experience with an ISA system may prompt a change in drivers’ cognitions. This is important given the wealth of literature which has argued that speed choice depends on psychological factors such as beliefs and attitudes (e.g., Conner et al., 2007; Elliott et al., 2007). If experience with ISA modified cognitions relating to speeding, this could contribute to a lasting change in behaviour. The Theory of Planned Behaviour (TPB: Ajzen, 1985), for example, is a social cognition model that can be used to describe the psychological determinants of speeding behaviour. The model proposes that intentions and perceived behavioural control (PBC) are the proximal determinants of behaviour. Intentions reflect the cognitive representation of an individual’s readiness to perform a given behaviour (Ajzen, 1991); PBC describes the individuals’ perception of the ease or difficulty of performing any given behaviour (Ajzen, 1991). It is assumed that PBC indirectly (via intentions) and directly influences behaviour. As intentions and PBC are held to be direct antecedents of behaviour, the model also states that intentions are influenced by three additional factors. Attitudes, subjective norms, and PBC are direct determinants of intentions. Attitude towards a behaviour reflects the overall evaluation of the behaviour and is believed to be determined by the product of the perceived likelihood
that a behaviour will result in certain outcomes and the evaluation of these outcomes, summed over the salient consequences (behavioural beliefs). Subjective norm refers to the perceived social pressure to engage or not engage in a behaviour and is understood to be based upon beliefs concerning what salient referents believe about the individual enacting the behaviour (normative beliefs), weighted by the individual’s motivation to comply with this group. Again PBC reflects the perceived ease or difficulty of undertaking a given behaviour. An individual’s perception of control is assumed to be the product of the individual’s evaluation of factors likely to facilitate/inhibit the performance of a behaviour and the frequency of their occurrence (control beliefs).

Ajzen (2005) argues that changes in attitudes, subjective norms and perceived behavioural control should produce changes in intentions, which in turn should lead to changes in behaviour (given adequate control over a behaviour). In order to change these global constructs Ajzen (2005) emphasises that the underlying behavioural, normative and control beliefs should be targeted for change or new salient beliefs designed to produce positive change should be introduced. Typically, persuasive messages are used to change or introduce beliefs but experience with ISA could indirectly achieve the former. For example, evidence suggests that drivers’ speed choice is related to the behavioural belief that speeding saves journey time (Warner and Aberg, 2008a). Since ISA trials have tended to demonstrate that complying with the speed limit does not necessarily increase journey time (e.g., Comte and Carsten, 1999), actual experience with an ISA system may serve to correct drivers’ beliefs relating to the perceived benefits of speeding, producing positive attitude change. Indeed, Fujii et al. (2001) found that drivers tended to have negative beliefs about public transport but following experience of using public transport, these beliefs were modified in a positive direction.

In terms of control, individuals are more likely to perform a behaviour when it is easy rather than difficult to perform. An individual’s perceived control is influenced by the extent of the opportunity to perform a behaviour and the availability of resources to help them in the performance of this behaviour. In their examination of control beliefs relating to speeding, Elliott et al. (2005) noted that clearly signed speed limits were perceived to facilitate speed limit compliance such that drivers’ who were more likely to believe this expressed stronger intentions to comply with the speed limit. Thus providing drivers with continual speed limit information via an ISA system could potentially raise an individual’s perceived behavioural control. PBC has also been likened to Bandura’s (1982) concept of self-efficacy; the individual’s self-appraisal (i.e., confidence) of how well they can perform actions necessary to deal with a future situation. Bandura suggests that self-efficacy beliefs comprise of four principal sources of information. These sources are active mastery experience, that is, the experience from performing similar tasks; vicarious experiences; verbal persuasion; and physiological and affective states. Bandura (1982) suggests that previous performance accomplishments are the most powerful source of self-efficacy such that successful performance tends to raise efficacy expectations and failures tend to lower it. Hence, driving with an ISA system that imposed control over the vehicle speed could increase PBC by providing an opportunity to engage in speed limit compliance with relative ease and repeated success.

Alternatively, if we are to believe that speeding is partially under the control of automatic processes (Elliott et al., 2003), ISA may provide a useful tool in establishing new habits. Whilst it is no doubt that speeding is, to a large extent, a deliberate behaviour rationalised by drivers, the automatic processes that may also govern this behaviour would suggest that speeding is somewhat resistant to behavioural change. Typical information based interventions would be unsuccessful in changing habituated behaviour since they rely upon the individual’s ability to control their behaviour, placing considerable demand on motivational resources and relying ultimately on a desire to change (Verplanken and Wood, 2006). When tackling established habits, Ouellette and Wood (1998) argue that the most effective behavioural change strategies are those that “impede performance of established behavior while facilitating formation of new behaviors into habits” (p. 70). Since an intervening ISA system imposes speed limit compliance, prolonged experience with this system may provide a stable context in which an individual can form new associations in memory between their actions and environment.

To date, only one study has used specific psychological theory to monitor changes in cognitions as a result of experience with an ISA system. As part of the Borlänge field trials, Warner and Aberg (2008b) collected measures of drivers’ attitudes, PBC, and subjective norm with respect to speeding before (March 2001) and during activation of a warning ISA system (December, 2001 and June, 2004). Comparisons of median values suggested that, a year after activation, drivers found it slightly more acceptable to exceed the speed limit and harder to comply with the speed limits. However, the difference was non-significant and in 2004, compared to December 2001, drivers held significantly less favourable attitudes towards speeding and perceived that they had significantly more control over complying with the speed limit. Although beliefs were not significantly different to those expressed before the activation of the system, median values were lower than those previously reported. Self-reported speeding, however, did not decline over time, suggesting that the small changes in cognitions observed were not sufficient to produce a change in intentions and behaviour. Whilst the results provide only modest evidence for the impact of ISA on cognitions, the results are based on a limited sample size \((n = 27)\). Furthermore, since the ISA system was purely informative, more substantial changes in cognitions may be observed following experience with an intervening ISA system as these systems strongly encourage speed limit compliance and make compliance much easier, thus providing the best opportunity to challenge drivers’ inaccurate beliefs. Accordingly, the aim of the present research was to examine the impact of long-term experience with an intervening but overridable ISA system on drivers’ cognitions and speeding behaviour.

2. Method

2.1. Design

The study was completed as part of a larger project examining driver behaviour with ISA by means of a set of long-term field trials (Carsten et al., 2008). In order to set the present study in context, details of the project methodology are presented.

Four field trials were undertaken using 20 ISA equipped vehicles. The first two field trials took place in Leeds, a large metropolitan area with a significant number of satellite towns linked by high flow radial routes. The final two field trials took place in South West Leicestershire. This trial was deemed more rural in nature with a large amount of commuter traffic using trunk roads, the major motorways and rural feeder roads. Two field trials were carried out in each area— one private trial and one fleet trial. Drivers recruited for the private trial used their vehicle for predominately personal, private use. Drivers within the fleet trial were recruited from local organisations. Here, drivers were encouraged by their employees to participate in the trial, so that drivers were arguably incentivised to use ISA and had the opportunity to interact with others using the system.

Each field trial lasted six months and adopted an ‘A–B–A’ design. In order to collect a measure of baseline driving behaviour, drivers were provided with an ISA vehicle and asked to undertake their
normal driving for 28 days (Phase 1). Following completion of this phase, the ISA system was enabled. ISA remained active for a total of 112 days. This extended period of driving over four months (Phase 2) provided the opportunity for drivers to experience all kinds of traffic scenarios and environments and minimised the occurrence of novelty effects in the data collected. On completion of this phase the ISA vehicle was again reconfigured to behave as a ‘normal’ vehicle thus allowing the evaluation of any carry-over effects from the ISA system. This final phase (Phase 3) of baseline data collection lasted for 28 days.

TPB questionnaires relating to speeding on a motorway, urban and residential road were administered at three time points: prior to drivers’ collection of the ISA vehicle (Time 1, month 0), upon completion of Phase 2 (Time 2, month 5) and upon completion of Phase 3 (Time 3, month 6). This design allowed the TPB to be used as a model for evaluating changes in cognitions as a result of using the ISA system for an extended period.

2.2. Participants

For the purposes of the ISA-UK project, drivers were recruited according to a number of criteria including age, gender and exposure (to maximise data collection). Due to a number of drivers withdrawing from the final trial due to sickness and accidents, the data analysis includes only 79 drivers. Consequently, 44 males (age range 22–59 years, \( M = 40.30, SD = 11.73 \)) and 35 females (age range 30–60 years, \( M = 41.43, SD = 8.05 \)) took part in the four trials. However, given the surveys were lengthy in nature and a number of drivers failed to complete some items on the questionnaires, the number of drivers included in the present analysis varies somewhat throughout.

2.3. The system

The system designed was an intervening ISA with an opt-out function (full details of the technical specification can be found in Lai et al., 2005). This system ‘knew’ the speed limit of the road on which it was travelling by means of an in-vehicle digital map onto which the speed limits had been coded and an on-board GPS unit. Using this information the system restricted the speed of the vehicle using the electronic throttle and a pneumatic actuator fitted to the brake pedal. The ISA system was overridable by the drivers, by means of a button on the steering wheel or a kick-down on the throttle pedal. As well as providing the speed limiting function, the ISA control computer also assumed the data logging functions. Data was recorded at 10 Hz. In addition to travelling speed and speed limits a number of other measures were recorded during the course of a trip, such as time stamps and coordinates etc.

2.4. Self-report measures

The TPB was applied to three speeding scenarios. These were:

**Speeding on a motorway:** Imagine you are driving along a motorway. It is a fine, dry day and the traffic is fairly light. The speed limit of the road is 70 mph.**

**Speeding on a residential road:** Imagine you are driving along a residential road with cars parked either side or connecting side roads at various points. Pedestrians are also visible. The speed limit of the road is 30 mph.

**Speeding on an urban road:** Imagine you are driving along an urban road. The traffic is fairly light. Although there are houses either side of the road there does not appear to be many pedestrians. The speed limit of the road is 40 mph.

The questionnaires included direct and indirect measures of the TPB constructs. In addition to the standard TPB measures a number of additional measures believed to influence intentions and behaviour were included. These comprised moral norms (Conner et al., 2007), anticipated regret (Conner et al., 2007; DfT, 2000), past behaviour (Elliott et al., 2003), self identity (DfT, 2000) and perceived susceptibility (Norman et al., 1999). Reliability analysis was computed for items within the individual scenarios and an overall reliability measure was computed across all speeding scenarios (overall speeding).

**Intention** was assessed using three items (e.g., ‘I would intend to exceed the 70 mph speed limit on a motorway’, strongly disagree–strongly agree, scored −3 to +3). The mean of these three items produced a composite scale for each of the three questionnaires. Higher scores reflected stronger intentions to engage in the behaviour. Reliability scores for the intention measures were good (time 1: \( \alpha = .83 \); time 2: \( \alpha = .72 \); time 3: \( \alpha = .75 \)).

**Attitude** was assessed by eight semantic differential scales following the appropriate statement (e.g., ‘Exceeding the 40 mph speed limit on an urban road would be...’). Following Lawton et al.’s (1997) distinction, the seven-point scales measured both instrumental (useless–useful, harmful–beneficial, negative–positive, bad–good) and affective attitudes (unsafe–safe, unsatisfying–satisfying, not enjoyable–enjoyable, reckless–cautious). Factor analysis with varimax rotation revealed inconsistent loading onto two factors across the three questionnaires. The two separate indexes for instrumental and affective attitudes were collapsed to form one attitude scale for each behaviour. The mean of the eight items (all scored −3 to +3) produced a composite scale for each of the behaviours such that higher scores indicated attitudes that were in favour of the commission of the behaviour. Reliability scores for the attitude measures were good (time 1: \( \alpha = .81 \); time 2: \( \alpha = .78 \); time 3: \( \alpha = .84 \)).

**Perceived behavioural control** (PBC) was assessed using six items. These items were differentiated in terms of perceived difficulty (two items; e.g., ‘For me to exceed the speed the 40 mph speed limit on an urban road would be...’, difficult–easy, scored +1 to +7), perceived control (three items; e.g., ‘How much control would you have over exceeding the speed limit on a motorway?’, no control–complete control, scored +1 to +7) and self-efficacy (one item; ‘How confident are you that you will be to exceed the 30 mph speed limit on a residential road?’, not very confident–very confident, scored +1 to +7), as proposed by Conner and Sparks (1996) and Trafimow et al. (2002). The mean of these six items produced a composite scale for each of the behaviours. Higher scores reflected greater perceptions of control in the commission of the behaviour. Reliability scores for the PBC measures were good (time 1: \( \alpha = .87 \); time 2: \( \alpha = .88 \); time 3: \( \alpha = .91 \)).

**Behavioural belief composites** were derived from the product of the behavioural belief strength (the perceived likelihood of modal outcomes) and outcome evaluation (evaluation of those outcomes). Behavioural beliefs were measured using nine items (e.g., ‘Exceeding the 70 mph speed limit on a motorway would risk causing an accident’, unlikely–likely, scored −3 to +3). Higher scores reflected beliefs that the outcome was likely. Outcome evaluations were assessed using nine items (e.g., ‘Making rapid progress would be... bad to good, scored −3 to +3). Higher scores reflected outcome evaluations that were positive.

**Normative belief composites** were derived from the product of the normative belief strength (expectations of significant others) and motivation to comply (the motivation to comply with significant others). Normative beliefs were measured using five items. Five salient referents were identified; the police, family, friends, other road users and other spouse/partner (e.g., ‘The police would

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1 Note that direct measures of subjective norm were not included as it has been suggested that individuals may find it difficult to average out the manner in which all significant others would expect them to behave (McMillan, 1998).
disapprove of me exceeding the 70 mph speed limit on a motorway, strongly disagree–strongly agree, scored –3 to +3). Higher scores reflected normative beliefs that opposed the behaviour. Motivations to comply were assessed using five items (e.g., ‘Generally speaking how much do you want to do what your family think you should do?’, not at all–very much, scored +1 to +7). Higher scores reflected a stronger motivation to comply with the referents.

Control belief composites were derived from the product of the control belief frequency (the frequency of occurrence of factor which would either facilitate or inhibit the behaviour) and the control belief power (the perceived power of these factors to facilitate or inhibit the behaviour). Control Beliefs were measured using seven items (‘Driving at night-time makes me exceeding the 40 mph speed limit’, unlikely–likely, scored –3 to +3). Higher scores reflected beliefs that the outcome was likely. Frequency of beliefs was measured using seven items (‘I drive on urban roads at night-time’, never–frequently, scored +1 to +7). Higher scores reflected behaviours that were more frequent.

Moral norm was assessed using a single seven-point item (‘It would be quite wrong for me to exceed the 30 mph on a residential road, strongly disagree–strongly agree, scored +1 to +7). Higher scores reflected stronger moral norms. Reliability scores for moral norm measures were good (time 1α = .74; time 2α = .72; time 3α = .79).

Anticipated regret was measured as the mean of two seven-point items (e.g., ‘I would regret exceeding the 40 mph speed limit on an urban road’, unlikely–likely, scored –3 to +3). Higher scores reflected stronger feelings of anticipated regret. Reliability scores for anticipated regret measures were good (time 1α = .86; time 2α = .88; time 3α = .87).

Past behaviour was tapped by two seven-point items (e.g., ‘In the past I have frequently exceeded the 70 mph speed limit on a motorway, strongly disagree–strongly agree, and scored +1 to +7). Higher scores reflected more frequent commission of the behaviour in the past. Reliability for past behaviour measures were good (time 1α = .77; time 2α = .76; time 3α = .80).

Self-identity was measured using one single item (e.g., ‘I see myself as a safe driver’, strongly disagree–strongly agree, scored +1 to +7). Higher scores reflected a stronger sense of self-identity.

Perceived susceptibility was assessed using two items (e.g., What is the risk of being involved in an accident if you exceed the 70 mph speed limit?); What is the risk of being involved in an accident if you do not exceed the 70 mph speed limit?, very low risk–very high risk, scored –3 to +3). For each respondent the difference between the two scales was calculated for each scenario, by subtracting the score if they did engage in the behaviour from that for if they did not. Thus the greater the difference the greater the effect of engaging in the behaviour, with a positive score suggesting that engaging in the behaviour made them more susceptible and a negative score suggesting it made them less susceptible. Reliability scores for perceived susceptibility measures were good (time 1α = .83; time 2α = .81; time 3α = .85).

2.5. Behaviour measure

Although a number of measures of speeding behaviour were available from the logged data, a measure that was closely matched to the TPB measures and also possessed a degree of fidelity was required. The chosen measure of speeding behaviour was defined as the percentage of distance travelled exceeding the speed limit on each class of road. Distance-based data was preferred since time based data can often introduce undue weight to the data stream when vehicle speed is zero (e.g., the vehicle stops at junctions) or very low (e.g., the vehicle moves slowly on a congested road). Conversion algorithms were therefore developed for extracting a record per 5 metres of travelling distance from the data stream.

Records without a valid speed limit (e.g., when the vehicle was driven on a road outside the mapped area, on a private road etc.) were removed from the analysis. A measure of behaviour for speeding in each of the scenarios was computed (i.e., percentage of distance spent speeding on 70, 30 and 40 mph roads). An overall measure of speeding was computed by averaging across scenarios. Across the three speeding scenarios, the percentage of distance travelled exceeding the speed limit measure showed good consistency within participants for each phase (time 1α = .60; time 2α = .57; time 3α = .65).

3. Results

A series of mixed design 3 × 2 × 2 ANOVAs (time point × gender × age) were carried out to assess the impact of the ISA intervention on the individual TPB constructs (Bonferroni correction was used in order to control the familywise error rate). For ease of comprehension the results are presented separately. Given the focus of the current research results pertaining to the main effect of time are initially presented (Table 1). The main effects of gender and age are then explored in order to identify any between driver differences in beliefs (Tables 2 and 3). Given the large number of tests, only significant main effects or interactions are reported. Note that higher order (3-4-way) interactions are omitted throughout analysis due to the difficulty in attributing meaningful explanations to these effects and lack of any consistent pattern.

Analysis relating to the changes in behaviour and the TPB constructs over time is presented in Table 1. As can be seen during the activation of ISA participants’ speeding behaviour was significantly reduced. As might be expected this coincided with a significant decrease in their past behaviour scores where ratings at time 1 were significantly higher than those reported at time 2 and time 3. Following experience with ISA, participants reported that they engaged in significantly less speeding. Importantly, participants’ also expressed significantly weaker intentions to exceed the speed limit following experience with ISA with ratings at 3 being significantly lower than those measured at time 1.

Although analysis did not reveal any significant change over time in direct measures of attitudes, PBC, moral norm, anticipated regret, self-identity or perceived susceptibility, analysis relating to indirect measures of the central constructs revealed some interesting changes (see Table 1). Following experience with ISA, participants were significantly less likely to believe that speeding would get them to their destination more quickly but were more likely to believe that speeding would make them feel good. With regard to normative beliefs, unexpectedly perceived social pressure not to speed appeared to decrease following immediate experience with ISA. However, ratings began to rise again following a return to unsupported driving. Similarly, participants’ motivation to comply with the stated referents was weaker following immediate experience with ISA but strengthened again following a return to unsupported driving. At the end of phase 2, having driven with ISA system for a prolonged period, participants were significantly less likely to believe that the police would disapprove of their speeding and were significantly less motivated to comply with the wishes of other roads users. Changes in control beliefs were minimal. Mean trends suggested the participants were significantly less likely to believe that being in a hurry would facilitate speeding and less likely to believe that driving in heavy traffic would inhibit speeding. In general, the frequency scores suggested that as time progressed drivers reported being less involved in the stated control factors. Only one interaction was noted such that following experience with the system, younger participants’ evaluation of getting to their destination more quickly was significantly more positive.
Several between driver differences were also observed. Differences amongst the sexes were most pronounced (see Table 2). Male drivers travelled at speeds over the speed limit for significantly greater distances than female drivers. Comparisons across the behavioural beliefs indicated that, compared to male participants, female participants were less positive in their evaluation of the benefits associated with speeding (e.g., save time, feel good) and more negative in their evaluation of the drawbacks associated with speeding. Compared to male participants, female participants held significantly less favourable attitudes towards speeding and expressed significantly stronger moral norms not to speed. Female participants were also significantly more likely than male participants to believe that speeding would risk causing an accident, get them stopped by the police and lead to prosecution and fine. Similarly, female participants rated the outcome of being involved in an accident significantly more negatively than male participants. In general mean trends suggested that female participants perceived greater social pressure from the five stated referents not to speed than male participants. In particular, females were significantly more likely to believe that the police would disapprove of their speeding. Compared to female participants however, male participants expressed a significantly stronger motivation to comply with their family or spouse/partner. In terms of control beliefs, female participants were more likely to believe that the stated control factors would inhibit speeding. Specifically, male participants were significantly more likely to believe that driving at night-time would facilitate speeding, significantly less likely to believe driving on wet surfaces would inhibit their speeding behaviour and significantly more likely to believe that driving in a bad mood would inhibit speeding.

Differences between older and younger participants were less apparent and inconsistent (see Table 3). Comparisons across the age groups suggested that young participants’ recorded speeding behaviour and self-reports of past speeding behaviour were significantly higher than that of their counterparts. Older participants were significantly more likely than younger participants to

<table>
<thead>
<tr>
<th>Construct</th>
<th>Mean Percentage of distance travelled speeding</th>
<th>Repeated measures ANOVA</th>
<th>Post hoc t-tests</th>
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<tbody>
<tr>
<td></td>
<td>Phase 1</td>
<td>Phase 2</td>
<td>Phase 3</td>
</tr>
<tr>
<td>Behaviour</td>
<td>33.21</td>
<td>27.67</td>
<td>33.01</td>
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<tr>
<td>Direct measures</td>
<td>0.90</td>
<td>1.14</td>
<td>1.28</td>
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<tr>
<td>Behavioural Beliefs</td>
<td>4.38</td>
<td>3.53</td>
<td>3.84</td>
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<tr>
<td>Outcome expectations</td>
<td>0.82</td>
<td>0.35</td>
<td>0.37</td>
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<tr>
<td>Normative beliefs</td>
<td>2.24</td>
<td>1.82</td>
<td>2.06</td>
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<tr>
<td>Motivation to comply</td>
<td>4.26</td>
<td>3.68</td>
<td>3.95</td>
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<tr>
<td>Control beliefs</td>
<td>0.75</td>
<td>0.46</td>
<td>0.51</td>
</tr>
<tr>
<td>Control Frequency</td>
<td>5.55</td>
<td>5.25</td>
<td>5.28</td>
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<tr>
<td>On wet surfaces</td>
<td>5.63</td>
<td>5.38</td>
<td>5.39</td>
</tr>
<tr>
<td>In a hurry</td>
<td>3.62</td>
<td>3.87</td>
<td>4.11</td>
</tr>
<tr>
<td>With a passenger</td>
<td>5.39</td>
<td>5.07</td>
<td>5.08</td>
</tr>
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*Denotes the mean difference is significant at the 0.05 level.
**Denotes the mean difference is significant at the 0.01 level.
***Denotes the mean difference is significant at the 0.001 level.
+x denotes the mean difference is not significant.
believe that speeding would make them feel anxious and rated the outcome of causing an accident significantly more negatively than younger participants. In general, older participants expressed a stronger motivation to comply with the salient referents than younger participants. Compared to younger participants, older participants were significantly more likely to believe that the police would disapprove of speeding. Younger participants were significantly less likely to believe that driving at night-time and on wet surfaces would inhibit speeding.

4. Discussion

The present study aimed to determine the impact of long-term experience with ISA on drivers’ cognitions. Whilst analysis demonstrated little significant impact upon the direct measures of the TPB, intentions to speed were reported to significantly weaken following long-term experience with the ISA system. Over the course of the ISA trial, drivers expressed significantly weaker intentions to exceed the speed limit. Examination of beliefs also provided encouraging results and suggested that, following experience with the ISA system, drivers were significantly less likely to believe that speeding would get them to their destination more quickly and less likely to believe being in a hurry would facilitate speeding. Although drivers still remained in agreement with these beliefs, the results tend to indicate that ISA went some way towards showing the drivers that speeding does not necessarily reduce journey times. This is especially important since research has shown that behavioural beliefs relating to “arriving quicker” (Warner and Aber, 2008a) and control beliefs relating to “being late/in a rush” (Elliott et al., 2005) reliably predict intentions to speed and intentions to comply with the speed limit. Ajzen and Driver (1991) argue that both direct and indirect measures of the TPB constructs predict intentions and behaviour. It seems reasonable to assume therefore that the direct measures failed to mediate the impact of the indirect measures and thus the positive changes in the underlying beliefs noted above account for the change in drivers’ intentions. Unfortunately it is beyond the scope of the current paper to test this assumption.

Although the drivers expressed positive intentions to alter their behaviour and demonstrated positive changes in their beliefs this failed to translate into behavioural change. Whilst speeding behaviour was shown to drop significantly during the ISA activation period, levels of speeding returned to those previously observed following the removal of the system. Results would therefore suggest that whilst active, ISA was effective in reducing behaviour. However without the support of the system, drivers were less likely to comply with the speed limit. Recent models of behaviour change (e.g., the Transtheoretical Model of Change (Prochaska and DiClemente, 1983)) which emphasize the difference between initiation and maintenance of a behaviour change may provide one potential explanation of the failure to elicit sustained behaviour change. These ‘stage’ models (see Conner and Norman, 2005) suggest that long-term behaviour change (i.e., maintenance) may be based on different determinants than short-term change (i.e., initiation). Thus ISA may have been successful in producing short-term change through influencing the cognitions underlying such change but may not be sufficient to produce long-term change because the appropriate cognitions were not altered. Further studies could usefully assess ways in which the implementation of an ISA system could be supplemented in order to produce changes in the

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<thead>
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<th>Construct</th>
<th>Mean Male</th>
<th>Mean Female</th>
<th>Univariate ANOVA</th>
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<tr>
<td>Behaviour</td>
<td>Percentage of distance travelled speeding</td>
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<td>Direct measures</td>
<td>Attitude</td>
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<td>Behavioural Beliefs</td>
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<td>Speeding would risk causing an accident</td>
<td>0.89</td>
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<td>Speeding would get me stopped by the police</td>
<td>1.12</td>
<td>2.29</td>
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<td>Speeding would get me prosecuted and fined</td>
<td>1.32</td>
<td>2.41</td>
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<td>Speeding would risk causing an accident</td>
<td>-2.86</td>
<td>-2.97</td>
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<td>Normative beliefs</td>
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<td>2.27</td>
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<td>Motivation to comply</td>
<td>Family</td>
<td>5.18</td>
<td>4.54</td>
</tr>
<tr>
<td></td>
<td>Spouse/partner</td>
<td>5.40</td>
<td>4.68</td>
</tr>
<tr>
<td>Control beliefs</td>
<td>At night-time</td>
<td>-0.08</td>
<td>-0.68</td>
</tr>
<tr>
<td></td>
<td>On wet surfaces</td>
<td>-1.57</td>
<td>-2.10</td>
</tr>
<tr>
<td></td>
<td>In a bad mood</td>
<td>0.02</td>
<td>-0.43</td>
</tr>
<tr>
<td>Control Frequency</td>
<td>With a passenger</td>
<td>4.38</td>
<td>5.42</td>
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</table>

<table>
<thead>
<tr>
<th>Construct</th>
<th>Mean Young</th>
<th>Mean Old</th>
<th>Univariate ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviour</td>
<td>Percentage of distance travelled speeding</td>
<td>33.72</td>
<td>28.88</td>
</tr>
<tr>
<td>Direct measures</td>
<td>Past behaviour</td>
<td>4.24</td>
<td>3.59</td>
</tr>
<tr>
<td>Behavioural Beliefs</td>
<td>Speeding would make me feel anxious</td>
<td>0.05</td>
<td>0.75</td>
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<tr>
<td>Outcome expectations</td>
<td>Speeding would risk causing an accident</td>
<td>-2.88</td>
<td>-2.96</td>
</tr>
<tr>
<td>Normative beliefs</td>
<td>The police would disapprove of my speeding</td>
<td>1.83</td>
<td>2.25</td>
</tr>
<tr>
<td>Control beliefs</td>
<td>At night-time</td>
<td>-0.02</td>
<td>-0.75</td>
</tr>
<tr>
<td></td>
<td>On wet surfaces</td>
<td>-1.64</td>
<td>-2.03</td>
</tr>
<tr>
<td>Control Frequency</td>
<td>In a hurry</td>
<td>4.08</td>
<td>3.65</td>
</tr>
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</table>

Table 2
ANOVA results main effect of gender.

Table 3
ANOVA results main effect of age.
cognitions that appear to underlie the maintenance of a reduction in speeding (e.g., producing stable intentions not to speed).

Alternatively, if speeding is a behaviour under the partial influence of habit, as some have argued (Elliott et al., 2003), the results would suggest that although ISA may have been successful in blocking habitual behaviour when activated, it was unsuccessful in establishing new compliant habits. Ouellette and Wood (1998) maintain that any intervention designed to change habitual behaviour should ensure an immediate positive response. Whilst reinforcement was not required to promote repetition (since the nature of the ISA system enforces repetition) the results might suggest that it does seem important in determining whether this new, enforced behaviour can then proceed relatively automatically. Outcomes of the new behaviour must be judged more favourably than the alternatives and it is the behavioural outcomes of efficiency, profitability and convenience that motivate change (Verplanken and Wood, 2006). Even if we are not to believe that speeding is under the control of habit, this argument could provide a potential explanation for the findings. Since the positive outcomes associated with complying with the speed limits are by their very nature never directly experienced (a reduction in accident risk, avoidance of prosecution or fines, reduced anxiety etc.) it seems reasonable to suppose that exceeding the speed limit with its immediate perceived reinforcements (feeling good, saving time etc.) is often judged as the more favourable outcome. Within this present study, the belief that speeding would make drivers ‘feel good’ strengthened following experience with ISA system and elsewhere, Warner and Aberg (2008a) noted that the belief “speeding makes me arrive quicker” predicted drivers’ intentions to exceed the speed limit on urban and rural roads. Thus, given research relating to the powerful influence of positive affect (Lawton et al., 1997) and the common misconception that speeding decreases journey time, establishing speed limit compliance with less obvious favourable outcomes presents a difficult problem. The results may also suggest that, without the support of the ISA system, drivers were more vulnerable to non-motivational pressures associated with driving such as pressure from traffic etc.

It is also important to note that, although the ISA intervention failed to elicit a sustained behaviour change, there was no indication of a negative carry-over effect: speeding behaviour remained stable and did not become more extensive. The significant reduction in speeding behaviour whilst ISA was activated also suggests that the effectiveness of the ISA was not compromised by the overridable system. Furthermore, examination of individual differences also suggested that the impact of ISA upon behaviour and cognitions did not alter according to a driver’s age or sex. Although it was not the main focus of the research to determine any general between driver differences, several significant differences in beliefs were identified. Differences between male and female drivers were the most pronounced. Findings here are in line previous research (Parker et al., 1992a; Parker et al., 1992b) and provide information that is useful for more traditional speeding campaigns.

5. Conclusions

Findings relating to the impact of ISA suggested that an overridable, intervening ISA significantly reduced the percentage of distance travelled whilst exceeding the speed limit. However although, when active, ISA served to significantly reduce speeding behaviour, failure to elicit a sustained change in behaviour when the system was removed suggested that the ISA intervention was unable to establish more compliant speeding behaviour. Despite this, there was encouraging evidence that the implementation of ISA could serve to change drivers’ intentions to speed. Indeed, with longer experience, more significant changes may be observed. Since the implementation path of ISA is undetermined, the current results provide preliminary evidence for the potential of the short term use of ISA as a tool for reducing speeding behaviour and establishing pro-safety cognitions.

References


