Application of the theory of planned behaviour to the prediction of objectively assessed breaking of posted speed limits

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In two studies the Theory of Planned Behaviour (TPB) including moral norms, anticipated regret and past behaviour was applied to predicting intention to exceed the posted speed limit across different roads and objectively assessed speeding behaviour. All measures except behaviour were taken by self-report questionnaires referring to different driving scenarios. The behaviour measures were based on performance in a simulator (Study 1) or unobtrusive on-road speed camera assessment taken without driver awareness (Study 2) across roads with varying posted speed limits. Results are reported averaged across road types in both studies. In Study 1 (N = 83), 82% of the variance in intentions to speed was explained, with attitudes, subjective norms, perceived behavioural control (PBC), moral norms, anticipated regret and past behaviour being significant predictors. A total of 35% of the variance in speed as assessed on a driving simulator was accounted for with intentions, PBC, moral norms and previous accidents being significant predictors. In Study 2 (N = 303), 76% of the variance in intentions to speed was explained with attitudes, moral norms, anticipated regret and past behaviour being significant predictors. A total of 17% of the variance in speed as assessed on-road was accounted for with intentions and moral norms being significant. Practical implications of the findings for road safety are discussed.

Driving at speeds in excess of the posted speed limit is both a relatively common behaviour and one with potentially severe negative consequences. Various studies have demonstrated the prevalence of exceeding the posted speed limit (‘speeding’) on a variety of roads (e.g. Lawton, Parker, Stradling, & Manstead, 1997b). It is also well established that increased driving speed both increases the risk of accident involvement

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(e.g. Finch, Kompfner, Lockwood, & Maycock, 1994; Taylor, Lynam, & Baruya, 2000; West, French, Kemp, & Elander, 1993) and the severity of injury should an accident occur (Ashton, 1981; Hobbs & Mills, 1984). Accident analysis in the UK has suggested that a 1 mph change in the average traffic speed is associated with a change of between 1.9% and 5.3% in accident rates (Taylor et al., 2000). Various studies have linked speeding behaviour to demographic characteristics such as gender, age, and driving experience (e.g. French, West, Elander, & Wilding, 1993; Stradling, 2000). However, there has been less research relating speeding to potentially modifiable motivational variables and even less research relating such factors to objectively assessed speeding behaviour. The present research tackled this issue by examining the impact of motivational and demographic variables on speeding behaviour assessed in a driving simulator (Study 1) and in on-road driving (Study 2). In identifying modifiable determinants of intentions and actual speeding behaviour we can provide appropriate targets for interventions aimed at changing this behaviour.

One potentially useful parsimonious model of the motivational influences on behaviour that has been employed in the driving area is the Theory of Planned Behaviour (TPB; Ajzen, 1985, 1991). The TPB (Figure 1, bottom part of figure), based on the earlier Theory of Reasoned Action (TRA: Ajzen & Fishbein 1980; Fishbein & Ajzen 1975), 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 is an additional variable in the TPB compared to the TRA and describes the individuals’ perception of the ease or difficulty of performing any given behaviour (Ajzen, 1991). In the TPB, PBC is assumed to indirectly (via intentions) and directly influence behaviour. The TPB is held to explain both volitional and non-volitional behaviours. 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. Attitudes towards a behaviour reflect...
the degree of positive or negative evaluation the individual has towards performing the behaviour. Subjective norms refer to the perceived social pressure to engage or not engage in a behaviour. As the relative importance of intentions and PBC in predicting behaviour can differ across behaviours and populations, so too can the importance of attitudes, subjective norms and PBC in the prediction of intentions. Underlying attitudes, subjective norms and PBC are beliefs that can form useful targets for interventions designed to change behaviour (see Hardeman et al., 2002). In applying the TPB to actual speeding behaviour the present research aimed to show the value of this approach in identifying key targets for interventions designed to change this socially important behaviour.

A considerable body of research supports the power of the TPB to predict intentions and behaviour across a range of behaviours (see Ajzen & Fishbein, 2005; Conner & Sparks, 2005; Eagly & Chaiken, 1993; Manstead & Parker, 1995 for reviews). For example, Armitage and Conner (2001) reported that across 154 applications, attitude, subjective norms and PBC accounted for 39% of the variance in intention, while intentions and PBC accounted for 27% of the variance in behaviour across 63 studies. In the driving domain a number of studies have applied the TPB to drivers propensity to speed (Lawton, Parker, Manstead, & Stradling, 1997a; Lawton et al., 1997b; Newman, Watson, & Murray, 2004; Parker, Manstead, Stradling, Reason, & Baxter, 1992b; Parker, Manstead, Stradling, & Reason, 1992a), dangerously overtake (Parker, Manstead, & Stradling, 1995; Parker et al., 1992b), drink and drive (Parker et al., 1992b), follow closely (Parker et al., 1992b), recklessly weave (Parker et al., 1995), recklessly cut in (Parker et al., 1995), run red traffic lights (Lawton et al., 1997a), flash at vehicles in front (Lawton et al., 1997a) and engage in retaliatory/initiatory violations (Parker, Lajunen, & Stradling, 1998).

A major criticism of the above studies is that they have contented themselves with predicting intentions to engage in the above driving behaviours. While intentions and behaviour might be expected to be correlated (Armitage & Conner, 2001 reported an intention-behaviour correlation of .47) the size of the relationship in the driving domain remains to be demonstrated. Only two studies have reported the prospective relationship between speeding intentions and speeding behaviour (Elliott, Armitage, & Baughan, 2003). Elliott et al. (2003) examined speeding in a built-up area and reported an intention–behaviour relationship of .67 over a 3-month time interval, while intentions and PBC accounted for 32% of the variance in behaviour after controlling for demographic variables. However, this study can be criticized for focusing on speeding in one particular driving context and for employing a self-report measure of behaviour which can lead to an overestimation of the relationships between intentions and behaviour. Although the correlation between self-reported and objectively assessed speeding is reported to be moderate (Corbett, 2001; Haglund & Aberg, 2000; Walton & Bathurst, 1998), the latter criticism is a particularly important one for the TPB.

In the meta-analysis of the TPB by Armitage and Conner (2001) a marked difference was observed between studies employing self-report and objectively assessed behaviour. In the former case, across 44 tests, intentions and PBC explained 31% of the variance in behaviour, while in the latter case, across 19 tests, intentions and PBC explained only 20% of the variance in behaviour. Clearly such differences may be attributable to a range of different factors including self-presentation biases (Paulhus, 1984, 2002). Such biases may be particularly important for socially undesirable behaviours such as speeding. We would argue that in such cases it is particularly valuable to identify the impact of TPB variables on objectively assessed speeding.
behaviour. Only one study has reported such an objective measurement of speeding based on performance in a driving simulator (Elliott et al., 2007). Elliott et al. (2007) reported that intentions were the only significant predictors of speeding behaviour accounting for between 31% (rural single carriageway roads) and 39% (village through roads) of the variance in speeding behaviour. However, this rose to 67% for self-reported speeding supporting previous research indicating that the power of the TPB to predict behaviour may be overestimated when using self-report measures of behaviour.

There are a number of difficulties in obtaining reliable and valid measures of driving behaviours such as speeding. The problems of using self-report measures have been noted elsewhere (Lajunen & Summala, 2003). Other measures include performance on driving simulators and observational measures. Each provides somewhat different challenges to reliability and validity. Driving simulators such as used by Elliott et al. (2007) can provide measures of speeding behaviour with high reliability and fidelity because data on speeding behaviours can be collected moment by moment by computer. They also provide optimal experimental control in that all drivers can be exposed to the same stimuli in terms of road characteristics and other hazards. However, it may also be the case that participants drive in a different manner on a simulator either because objective risks are less apparent or because of self-presentation biases. In contrast, observational measures of speeding, particularly when taken unobtrusively and without awareness, are less likely to be open to such influences and so possess greater ecological validity. However, such data bring different difficulties. First, such behaviour is likely to be influenced by a range of non-motivational factors (e.g. traffic flow and volume, road conditions, weather). Second, if we wish to ensure that the observational data are not influenced by any ‘subject’ biases then it is necessary to collect these data before any self-report measures. Such a procedure does not preserve the presumed causal ordering between TPB variables and behaviour. Rather, we need to assume that the observed speeding behaviour is representative of future speeding behaviour. We would argue that simulator measures and unobtrusive observational measures of speeding have complementary characteristics in relation to validity. In employing these different methods of behaviour measurement in the two studies reported here consistent findings across studies would provide a powerful and persuasive test of the TPB in relation to predicting objectively assessed speeding behaviour.

The TPB assumes that any other influences on intentions and behaviour are mediated through components of the TPB (Ajzen, 1991). However, a growing number of studies have demonstrated the impact of additional variables on intentions and behaviour, even after the TPB variables have been taken into account (for reviews see Conner & Armitage, 1998; Conner & Sparks, 2005). Three such key variables are considered here in the two reported studies: moral norms, anticipated regret and past behaviour (see Figure 1).

Moral norms are the individual’s perception of the moral correctness or incorrectness of performing a behaviour (Ajzen, 1991) and take account of, ‘...personal feelings of ... responsibility to perform, or refuse to perform, a certain behavior’ (Ajzen, 1991, p. 199). Moral norms might be expected to have an important influence on the performance of those behaviours with a moral or ethical dimension (e.g. Beck & Ajzen, 1991). Speeding behaviour may constitute such a behaviour because of the potential for causing harm to oneself and others (Parker et al., 1995). Conner and Armitage (1998) reported the correlation between moral norms and intentions to be $r = 0.50$ across 11 TPB studies. Moral norm added (on average) 4% to the prediction of intention after taking account of other TPB variables, a change which was significant. On the basis of previous research we predicted that moral norms not to speed would be
a significant additional predictor of intentions to speed. As Godin, Conner, and Sheeran (2005) note, the vast majority of studies that showed an impact of moral norms on intentions did not show a similar impact on behaviour, at least when intentions were included in the analyses. Nevertheless, there are occasional studies demonstrating such a direct impact (e.g. Godin, Gagnon, & Lambert, 2003) and no previous study has tested this relationship for driving behaviours. We therefore also tested this effect of moral norms on speeding behaviour.

The TPB assumes that people are logical and rational in their decision-making, systematically using the information available to them (Richard, de Vries, & van der Pligt, 1998). However, it has been suggested that, a possible shortcoming of its utilitarian approach is its exclusion of affective processes (Conner & Armitage, 1998), despite the evidence that emotional outcomes are commonly factored into decision-making (van der Pligt, Zeelenberg, van Dijk, de Vries, & Richard, 1998). Regret is a negative, cognitive based emotion that is experienced when we realize or imagine that the present situation could have been better had we acted differently. Several studies have highlighted the role of anticipated regret in decision-making (e.g. Bell, 1982; Loomes & Sugden, 1982; Ritov & Baron, 1995). Factor analytic studies (Richard, van der Pligt, & de Vries, 1996a; Sheeran & Orbell, 1999) have demonstrated that regret is distinct from the other components of the TPB (attitude, subjective norms, PBC). Other studies have shown that, over and above the components of the TPB, anticipated regret adds to the predictions of intentions to use condoms (Bakker, Buunk, & Manstead, 1997; Conner, Graham, & Moore, 1999; Richard et al., 1998; Richard, van der Pligt, & de Vries, 1995, 1996a, 1996b; van der Pligt & Richard, 1994), engage in casual sex (Conner & Flesch, 2001; Richard et al., 1995); eat junk food, use soft drugs and drink alcohol (Richard et al., 1996a); protect one’s health and exercise (Conner & Abraham, 2001); not initiate smoking (Conner, Sandberg, McMillan, & Conner, 2006); provide practical assistance and emotional support to parents (Rapaport & Orbell, 2000) and commit driving violations (Parker et al., 1995). In a recent meta-analysis of TPB studies using regret, Sandberg and Conner (2005) found the correlation between regret and intentions to be $R^2 = 0.46$ ($N = 9257$ participants, $k = 25$ studies). More importantly regret explained an additional 4.4% of the variance in intentions after taking account of attitude, subjective norm and PBC ($p < .0001$). Given previous findings with driving violations (Parker et al., 1995) we predicted that anticipated regret would be an important additional predictor of the intention to speed.

A further additional variable that has been added to the TPB is past behaviour. Past behaviour is typically the strongest predictor of intention and behaviour, explaining variance over and above that accounted for by the TPB variables (see Ajzen, 1991; Conner & Armitage, 1998; Ouellette & Wood, 1998). For example, Conner and Armitage reported that the addition of past behaviour to the TPB variables explains, on average, an additional 7% of the variance in intention and 13% of the variance in behaviour. Clearly past behaviour does not cause subsequent behaviour. However, frequent performance of a behaviour may bring subsequent behaviour under the control of habitual processes and make subsequent performance more likely. We examined the extent to which past behaviour explained additional variance in intentions and objectively observed speeding behaviour. Given the nature of driving and the frequency with which previous speeding may have occurred we predicted that past behaviour would have a significant impact on both speeding intentions and behaviour because of the likelihood of speeding coming under the control of habitual processes.
In summary, the present research sought to apply a TPB including moral norms, anticipated regret, past behaviour, and demographic and driving variables (see Figure 1) to predicting speeding intentions and speeding behaviour across a range of contexts in two studies employing two different objectively assessed measures of behaviour. Both moral norms and anticipated regret are believed to be especially relevant, since committing driving violations such as speeding is a socially undesirable behaviour that may evoke anticipatory feelings of negative or indeed positive affect. The two studies also have complementary strengths and weaknesses in examining the impact of TPB variables on speeding behaviour. The use of a driving simulator in Study 1 allowed us to assess the predictor variables prior to behaviour assessment and maintain optimal experimental control (Kaptein, Theeuwes, & Van der Horst, 1996) over the measurement of speeding without the risks of on-road driving. As a method of data collection, the simulator is commonly criticized for its lack of ecological validity (Neale & Liebert, 1986) because those social and motivational pressures common to everyday driving are removed. Work has, however, found that drivers on a simulator do report feeling motivational factors such as time pressure even without the imposition of a time penalty (Comte, 2000) and it has been applied to predicting speeding using the TPB (Elliott et al., 2007). In Study 2 the objectively measured on-road speeding in different driving situations, taken without participant awareness, clearly has good ecological validity. However, the need to obtain the speeding measure before the measures of the predictor variables does not preserve the presumed causal ordering between TPB variables and behaviour. We argue the two studies together provide a powerful test of the TPB in relation to objectively assessed speeding behaviour.

STUDY 1
Study 1 examined the power of the TPB to predict objectively assessed speeding across four different driving situations. In order to simplify the reporting of the data we averaged across contexts in order to predict speeding behaviour across contexts. TPB measures were assessed by self-report questionnaire, while an objective measure of speeding was obtained in a driving simulator. The data reported were collected as part of a larger unpublished study on new driving technologies. Only data relevant to the reported analysis are discussed.¹

Method
Study design
The study was prospective in design. At time 1, a convenience sample of adult drivers were recruited to the study and they completed a self-report questionnaire assessing demographic, driving-related and TPB variables. At time 2, later the same day, participants attended the University of Leeds and used the driving simulator to drive a short sample route to familiarize themselves with the driving simulator. Immediately afterwards participants drove the experimental route during which speeding behaviour was assessed. On completing the drive participants were debriefed and paid (£15) for their participation.

¹ In Study 1 the range of other measures included sensation seeking, personality measures and subjective mental workload.
Participants
One hundred and twenty-eight drivers (78 males, 50 females, age range 19–78 years, $M = 37.0$ years, $SD = 13.5$) were recruited to participate in the study from a convenience sample of adults who had previously volunteered to participate in studies using the simulator. Simulator sickness, a visually induced form of motion sickness due to the simulator’s fixed base (Yoo, 2000), led to a significant proportion of the sample not completing the study. Eighty-three drivers fully completed the study (56 males, 27 females, age range 19–69 years, $M = 35.4$ years, $SD = 13.8$). However, there were no differences on the measured variables between those who did and did not complete the study ($F(10, 113) = 0.90$, ns).2 Previous experience with the simulator varied across drivers but was not predictive of speeding behaviour and therefore we did not control for this variable in the analyses.

Leeds driving simulator
The investigation was carried out in the University of Leeds Advanced Driving Simulator (LADS). The fixed base simulator retains its fully operational basic controls and dashboard instrumentation and provides feedback through steering torques at the steering wheel. A fully textured, anti-aliased, 3D graphical scene of the virtual world is projected onto a 2.5 m-radius cylindrical screen in front of the car, allowing a horizontal field of view of 230° and a vertical field of view of 39°. A rear view (60°) is back-projected onto a screen behind the car providing the view that would be seen through the vehicle’s rear view and wing mirrors. The frame rate is a fixed 30 Hz.

The validity of measures of driving behaviour taken on the LADS has been documented in several studies. In relation to the speed measurements taken here, Carsten, Groeger, Blana, and Jamson (1997) demonstrated a high degree of absolute correspondence between simulator and real life driving speeds. In addition, speed and distance appear to be sufficiently well represented within the LADS to allow inferences to be made about speed and distance perception in normal driving (Groeger, Carsten, Blana, & Jamson, 1999).

The experimental route on the simulator was approximately 22 miles in length and involved driving within urban, rural, motorway and arterial (urban) road environments (with speed limits clearly indicated). Within each of these environments the surrounding traffic was choreographed such that the participant drove as a lone vehicle, following a vehicle in front and also as a leader in a platoon of vehicles. The experimental route required approximately 14 minutes of driving, within which drivers were given three and a half minutes of driving in each road environment. Participants were asked to drive as they would normally.

Although a number of measures of speeding behaviour were available from the simulator, we attempted to select a measure that was closely matched to the TPB measures and also possessed a degree of fidelity. The simulator measure of speeding behaviour was defined as the percentage of time (in seconds) spent driving at 10 mph or more in excess of the speed limit on each class of road. Data were collected at 30 Hz. Across the four driving situations the percentage time speeding measure showed good consistency within participants (overall, Cronbach’s $\alpha = .74$).

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2 Given the modest sample size in Study 1 and the relatively large numbers of predictors, we repeated the regression analyses with intentions as the dependent variable using the full sample ($N = 128$). The results were substantively unchanged, supporting the idea that the modest sample size did not unduly affect the findings.
Questionnaire measures
The questionnaire was based on a scenario methodology used in previous studies (Parker et al., 1992b, 1995). Each scenario minimized contextual details but broadly matched the roads on the simulator and included a photograph of a real road (e.g. ‘The questionnaire on the following page is part of a study concerned with drivers’ thoughts related to exceeding imposed speed limits on an urban road. In order to complete the questionnaire it may help you to imagine you are driving on an urban road. It is a fine and dry day. The road is a single carriageway with shops and parked cars either side. Pedestrians are also visible. The posted speed limit is 30 mph’).³

Demographic and driving measures
The following demographic variables were measured: age, gender (1 = male, 2 = female). We also assessed several driving measures: number of years driving licence held (experience), annual mileage (in thousands of miles), and number of accidents (minor and major) over the last 5 years (converted to an annual average).

The following measures were operationalized in relation to speeding for each road scenario: rural road, motorway, urban road, and arterial road. These were combined to give overall measures in relation to speeding.

Intentions to speed
This was assessed using four items (e.g. ‘I intend to refrain from driving 10 mph or more above the posted speed limit on an urban road during the day’, definitely do-definitely do not, 7-point scale scored −3 to +3). The mean of these four items produced a composite scale for each of the four questionnaires (Motorway, Cronbach’s α = .93; Rural, α = .93; Arterial, α = .91; Urban, α = .87; Overall, α = .93) with higher scores indicating greater intentions to speed.

Attitudes to speeding
This was assessed by eight semantic differential scales following the statement ‘For me to refrain from driving 10 mph or more above the speed limit on a rural road during the day would be . . .’. Following Lawton et al.’s (1997b) distinction, the 7-point scales measured both instrumental (useful-useless, beneficial-harmful, positive-negative, bad-good) and affective attitudes (dangerous-safe, unpleasant-pleasant, not at all exciting-exciting, stress-free-stressful). Factor analysis with varimax rotation revealed inconsistent loading onto two factors across the four questionnaires. The two separate indexes for instrumental and affective attitudes were collapsed to form one attitude scale for each of the behaviours (Motorway, Cronbach’s α = .82; Rural, α = .85; Arterial, α = .84; Urban, α = .84; Overall, α = .92) such that higher scores indicate more positive attitudes to speeding.

Subjective norms about speeding
This was measured using three items (e.g. ‘Most people who are important to me think I should refrain from driving 10 mph or more above the posted speed limit on a motorway

³All measures used in Study 1 are available from the first author on request.
Predicting speeding
during the day, likely-unlikely, scored −3 to +3). The mean of the three items produced a composite scale for each of the questionnaires, although some of the internal reliabilities were relatively modest (Motorway, Cronbach’s $\alpha = .69$; Rural, $\alpha = .60$; Arterial, $\alpha = .60$; Urban, $\alpha = .69$; Overall, $\alpha = .87$). Higher scores reflected subjective norms that were more in favour of speeding.

**Perceived behavioural control over speeding**
PBC was assessed using six items. These items were differentiated in terms of perceived difficulty (two items; e.g. ‘For me to refrain from driving 10 mph or more above the speed limit on an arterial road during the day would be . . . , easy–difficult, scored +1 to +7), perceived control (three items; e.g. ‘How much control do you have over refraining from driving 10 mph or more above the speed limit on an arterial road during the day? Complete control–no control, scored +1 to +7) and self-efficacy (one item; ‘How confident are you that you will be able to refrain from driving 10 mph or more above the speed limit on an arterial road during the day? not very confident–very confident, scored +1 to +7), as proposed by Conner and Sparks (1996) and Trafimow, Sheeran, Conner, and Finlay (2002). Factor analysis with varimax rotation revealed inconsistent loading onto three factors across the four questionnaires. The three indexes for perceived behavioural control were collapsed to form one scale. The mean of these six items produced a composite scale for each of the behaviours (Motorway, Cronbach’s $\alpha = .76$; Rural, $\alpha = .76$; Arterial, $\alpha = .77$; Urban, $\alpha = .74$; Overall, $\alpha = .90$). Higher scores reflected greater perceptions of control over speeding.

**Moral norm to not speed**
This was assessed using a single 7-point item (‘It would be quite wrong for me to drive 10 mph or more above the posted speed limit on an urban road during the day’, strongly disagree-strongly agree, scored +1 to +7). Higher scores reflected moral norms not to speed (Overall, $\alpha = .76$).

**Anticipated regret over speeding**
This was measured as the mean of two 7-point items (e.g. ‘I would regret driving 10 mph or more above the posted speed limit on a rural road during the day’, unlikely-likely, scored +1 to +7). Inter-item reliability for this scale was high (Motorway, Cronbach’s $\alpha = .86$; Rural, $\alpha = .92$; Arterial, $\alpha = .93$; Urban, $\alpha = .83$; Overall, $\alpha = .94$). Higher scores reflected greater feelings of anticipated regret about speeding.

**Past speeding behaviour**
This was tapped by two 7-point self-report items (e.g. ‘During the past I frequently drove 10 mph or more above the posted speed limit on a motorway’, strongly disagree-strongly agree, scored +1 to +7). The mean of these two items provided a composite scale (Motorway, Cronbach’s $\alpha = .77$; Rural, $\alpha = .80$; Arterial, $\alpha = .71$; Urban, $\alpha = .92$; Overall, $\alpha = .82$) with higher scores indicating more frequent previous speeding.

**Results**

**Descriptive statistics and correlations**
All analyses were based on responses averaged across road types. In Table 1 (above diagonal) means, standard deviations, and zero-order correlation coefficients for all
measures are reported. The sample had a mean age of 35 years and had held a driving license for a mean of 16 years. They drove a mean of 16,000 miles per year and had a mean of 0.2 accidents per year (over the past 5 years). On average, the sample reported an intention not to speed, a negative attitude towards speeding and perceived subjective norms not to speed (all mean scores below zero). They also reported relatively low PBC over speeding and reported relatively frequent speeding in the past. The sample also, on average, reported high moral norms not to speed and an anticipated regret about speeding slightly below the mid-point. Finally, the simulator data indicated that on average they were exceeding the speed limit by 10 mph or more for 19% of the drive.

Examination of the zero-order correlations indicated that from the demographic variables number of accidents was significantly positively related to self-reported previous speeding, intentions to speed and speeding behaviour on the simulator. Age and experience were both significantly negatively related to self-reported previous speeding and intentions to speed (Table 1). Consistent with the TPB, attitude, subjective norms, and PBC were significantly positively correlated with intentions, while intentions and PBC were significantly correlated with behaviour (as was subjective norm). Past behaviour was significantly positively correlated with intentions and behaviour. Finally, moral norm and anticipated regret were significantly negatively correlated with intentions and behaviour.

Prediction of intentions to speed
Hierarchical regression analysis was used to assess the impact of our various measures on intentions to speed. At a first step the demographic variables were entered followed by the TPB variables of attitude, subjective norms and PBC at step 2. At a final step the additional variables moral norms, anticipated regret and past behaviour were entered (Table 2). Such an approach to the analysis of the additional variables is consistent with predictions based on the TPB. The results indicated that the demographic variables did not account for a statistically significant proportion of the variance in intentions ($R^2 = .11$, $F(5, 77) = 1.97$, ns), although accidents were marginally significantly related to intentions ($\beta = .21, p < .10$). Entry of the TPB variables at step 2 resulted in a substantial and statistically significant increment in the explained variance ($R^2_{change} = .53, F(3, 74) = 36.0, p < .001$). Examination of the beta weights indicated that subjective norms and PBC each has a significant positive beta weight, with subjective norms providing the strongest prediction. Attitude was not significantly related to intentions. At step 3, entry of the additional variables resulted in a further statistically significant increment in the explained variance ($R^2_{change} = .19, F(3, 71) = 25.8, p < .001$). Examination of the beta weights indicated moral norms and anticipated regret to have significant negative beta weights and past behaviour to have a significant positive beta weight. Attitude, subjective norms and PBC were significant at this step while the demographic variables remained non-significant. Past behaviour provided the strongest prediction. In order to get a better estimate of the predictive power of each variable we re-ran the regression only including the significant predictors and examined the squared semi-partial correlation coefficients to assess the unique variance associated with each predictor. In this equation 82% of the variance in intentions was explained with approximately 17% attributable to unique and 65% common variance effects (Unique variances: past behaviour 6%, PBC 3%, moral norm 3%, attitude 2%, anticipated regret 2%, subjective norms 1%).
### Table 1. Means, standard deviations and intercorrelations for all study variables: Study 1 (N = 83) above, Study 2 (N = 303) below diagonal

<table>
<thead>
<tr>
<th>Variables</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
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<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
<th>11.</th>
<th>12.</th>
<th>13.</th>
<th>Mean</th>
<th>SD</th>
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<td>-0.25</td>
<td>-0.01</td>
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<td>-0.24</td>
<td>16.35</td>
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<td>-0.07</td>
<td>-0.04</td>
<td>-0.04</td>
<td>0.19</td>
<td>0.07</td>
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<td>0.07</td>
<td>0.00</td>
<td>13.62</td>
<td>13.93</td>
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<tr>
<td>5. Number of accidents</td>
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<td>0.17</td>
<td>1.00</td>
<td>0.30</td>
<td>0.26</td>
<td>0.04</td>
<td>0.03</td>
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<td>-0.15</td>
<td>0.25</td>
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<td>-0.25</td>
<td>-0.22</td>
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<td>0.02</td>
<td>1.00</td>
<td>0.48</td>
<td>0.10</td>
<td>0.27</td>
<td>0.44</td>
<td>-0.47</td>
<td>-0.28</td>
<td>-0.23</td>
<td>18.69</td>
<td>25.85</td>
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<td>7. Intentions</td>
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<td>-0.30</td>
<td>-0.20</td>
<td>0.25</td>
<td>0.08</td>
<td>0.41</td>
<td>1.00</td>
<td>0.36</td>
<td>0.67</td>
<td>0.59</td>
<td>-0.65</td>
<td>-0.69</td>
<td>0.71</td>
<td>-0.50</td>
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<td>8. Attitudes</td>
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<td>0.19</td>
<td>-0.02</td>
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<td>-0.18</td>
<td>0.05</td>
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<td>-0.12</td>
<td>0.01</td>
<td>0.09</td>
<td>0.06</td>
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<td>-0.08</td>
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<td>0.04</td>
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<td>-0.08</td>
<td>-0.33</td>
<td>-0.74</td>
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<td>0.53</td>
<td>-0.35</td>
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</tr>
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<td>12. Anticipated regret</td>
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<td>0.11</td>
<td>-0.00</td>
<td>-0.20</td>
<td>-0.04</td>
<td>-0.25</td>
<td>-0.67</td>
<td>-0.59</td>
<td>-0.12</td>
<td>-0.47</td>
<td>0.71</td>
<td>1.00</td>
<td>-0.61</td>
<td>3.40</td>
<td>1.51</td>
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<tr>
<td>13. Past behaviour</td>
<td>-0.14</td>
<td>-0.32</td>
<td>-0.23</td>
<td>0.25</td>
<td>0.09</td>
<td>0.31</td>
<td>0.77</td>
<td>0.55</td>
<td>0.23</td>
<td>0.63</td>
<td>-0.59</td>
<td>-0.47</td>
<td>1.00</td>
<td>4.73</td>
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<td>48.43</td>
<td>31.39</td>
<td>13.66</td>
<td>0.06</td>
<td>42.56</td>
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<td>-1.08</td>
<td>-1.51</td>
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<td>4.90</td>
<td>4.00</td>
<td>3.45</td>
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<tr>
<td>SD</td>
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<td>13.80</td>
<td>11.49</td>
<td>0.14</td>
<td>4.92</td>
<td>1.32</td>
<td>1.18</td>
<td>1.20</td>
<td>1.20</td>
<td>1.18</td>
<td>1.54</td>
<td>1.09</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Above diagonal \( r > 0.22, p < 0.05; r > 0.27, p < 0.01; r > 0.36, p < 0.001 \); below diagonal \( r > 0.12, p < 0.05; r > 0.15, p < 0.01; r > 0.19, p < 0.001 \); 2-tailed.
Hierarchical regression analysis was also used to assess the impact of the demographic and TPB variables on speeding behaviour as measured on the simulator. At a first step the demographic variables were entered followed at step 2 by the TPB variables of intentions and PBC. At a third step the TPB variables of attitude and subjective norms were entered consistent with the TPB. At a final step the additional variable of moral norms, anticipated regret and past behaviour were entered (Table 3). The results indicated that the demographic variables did not account for a statistically significant proportion of the variance in behaviour ($R^2 = .11, F(5, 77) = 1.97, \text{ns}$), although accidents were significantly related to speeding behaviour ($\beta = .26, p < .05$). Entry of the TPB variables at step 2 resulted in a statistically significant increment in the explained variance ($R^2_{\text{change}} = .20, F(2, 75) = 10.9, p < .001$). Examination of the beta weights indicated intention and PBC each to have significant positive beta weights, although accidents were no longer significant. Entry of the remaining TPB variables at step 3 did not result in a statistically significant increment in the explained variance ($R^2_{\text{change}} = .01, F(2, 73) = .33, \text{ns}$). Examination of the beta weights indicated that only intention and PBC had significant beta weights at this step. At step 4, entry of the additional variables resulted in a further statistically significant increment in the explained variance ($R^2_{\text{change}} = .10, F(3, 70) = 4.18, p < .01$). Examination of the beta weights indicated moral norms to have a significant negative beta weight. Anticipated regret and past behaviour were non-significant. Intentions and PBC remained significant at this step while accidents were also significant. In order to get a better estimate of the predictive power of each variable we re-ran the regression only including the significant predictors and examined the squared semi-partial correlation coefficients to assess the unique variance associated with each predictor. In this equation 35% of the variance in behaviour was explained, with approximately 15% attributable to unique and 20% common variance effects (Unique variances: moral norm 5%, PBC 4%, accidents 4%, intentions 2%).

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictors</th>
<th>$R^2$</th>
<th>$R^2_{\text{change}}$</th>
<th>$F_{\text{change}}$</th>
<th>$\beta_{\text{Step 1}}$</th>
<th>$\beta_{\text{Step 2}}$</th>
<th>$\beta_{\text{Step 3}}$</th>
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<td>.11</td>
<td>1.97</td>
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<td>-.07</td>
<td>-.03</td>
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<td>Age</td>
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<td></td>
<td></td>
<td>-.34</td>
<td>-.35</td>
<td>-.11</td>
</tr>
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<td></td>
<td>Experience</td>
<td></td>
<td></td>
<td></td>
<td>.09</td>
<td>.20</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td>Annual mileage</td>
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<td></td>
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<td>.02</td>
<td>-.07</td>
<td>-.06</td>
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<td>.06</td>
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<td>.18**</td>
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<td></td>
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<td>.19**</td>
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<tr>
<td></td>
<td>PBC</td>
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<td></td>
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<td>.35***</td>
<td>.20***</td>
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<td>Moral norms</td>
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<td>.19</td>
<td>28.84***</td>
<td>- .22***</td>
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<td></td>
<td></td>
<td></td>
<td>-.17*</td>
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</tr>
<tr>
<td></td>
<td>Past speeding behaviour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.34***</td>
<td></td>
</tr>
</tbody>
</table>

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

**Prediction of speeding behaviour**

Hierarchical regression analysis was also used to assess the impact of the demographic and TPB variables on speeding behaviour as measured on the simulator. At a first step the demographic variables were entered followed at step 2 by the TPB variables of intentions and PBC. At a third step the TPB variables of attitude and subjective norms were entered consistent with the TPB. At a final step the additional variable of moral norms, anticipated regret and past behaviour were entered (Table 3). The results indicated that the demographic variables did not account for a statistically significant proportion of the variance in behaviour ($R^2 = .11, F(5, 77) = 1.95, \text{ns}$), although accidents were significantly related to speeding behaviour ($\beta = .26, p < .05$). Entry of the TPB variables at step 2 resulted in a statistically significant increment in the explained variance ($R^2_{\text{change}} = .20, F(2, 75) = 10.9, p < .001$). Examination of the beta weights indicated intention and PBC each to have significant positive beta weights, although accidents were no longer significant. Entry of the remaining TPB variables at step 3 did not result in a statistically significant increment in the explained variance ($R^2_{\text{change}} = .01, F(2, 73) = .33, \text{ns}$). Examination of the beta weights indicated that only intention and PBC had significant beta weights at this step. At step 4, entry of the additional variables resulted in a further statistically significant increment in the explained variance ($R^2_{\text{change}} = .10, F(3, 70) = 4.18, p < .01$). Examination of the beta weights indicated moral norms to have a significant negative beta weight. Anticipated regret and past behaviour were non-significant. Intentions and PBC remained significant at this step while accidents were also significant. In order to get a better estimate of the predictive power of each variable we re-ran the regression only including the significant predictors and examined the squared semi-partial correlation coefficients to assess the unique variance associated with each predictor. In this equation 35% of the variance in behaviour was explained, with approximately 15% attributable to unique and 20% common variance effects (Unique variances: moral norm 5%, PBC 4%, accidents 4%, intentions 2%).
Discussion

The results for Study 1 are consistent with and extend findings reported in previous studies (e.g. Parker et al., 1992b). Attitudes, subjective norms, PBC, moral norms, anticipated regret and past behaviour predicted individual’s intentions to exceed the posted speed limit by 10 mph or more explaining 82% of the variance. Intentions, PBC, moral norms and accidents predicted individual’s speeding behaviour on the simulator, explaining 35% of the variance. There was no impact of demographic variables on intentions or behaviour. Although past behaviour showed a significant unmediated impact on intentions there was no such significant effect on speeding behaviour. Despite a relatively modest sample size, the findings support those of Elliott et al. (2007) in demonstrating intentions to be the strongest predictor of speeding behaviour as assessed on a simulator, but also indicate the additional predictive power of moral norms.

STUDY 2

Study 2 sought to extend Study 1 by employing a discrete measure of speeding behaviour on the road. Again we examined the power of the TPB to predict objectively assessed speeding across different driving situations. In order to simplify the reporting of the data we averaged across contexts in order to predict speeding behaviour across speed zones. TPB measures were assessed by self-report questionnaire, while an objective measure of speeding was obtained by speed camera. The data reported were collected as part of a larger study and parts of the data have been reported previously (see Parker, 1997). Only data relevant to the reported analysis are discussed.4

4 The additional measures included behavioural beliefs about speeding. All measures used in Study 2 are available from the first author on request.
Method

Study design
The study was carried out in conjunction with the UK Transport Research Laboratory (TRL) who collected the observational data, the UK Driver and Licensing Authority (DVLA) who provided names and addresses of registered keepers of observed vehicles, and Gallup Poll who interviewed the drivers of the observed vehicles.

On-road speed assessment
The behavioural measure was obtained by means of infrared detection equipment linked to video cameras. Equipment was set up at various points on four different roads to unobtrusively film and record the speed of all passing vehicles along with a record of time and date. Each road included stretches with 30 mph, 40 mph and 60 mph posted speed limits and were selected to match those described in the scenarios used in the questionnaires (see below). Cars included in the study were observed in each of the three speed zones. We excluded cars that were not travelling in excess of the posted speed limit and that did not have at least 3 seconds headway (in case the lack of headway was reducing the driven speed). Licence plate numbers were submitted to DVLA who were able to provide names and addresses of the registered keepers of 726 of 750 vehicles observed. The observed speeding measure was computed as the mean speed across the three speed zones (Cronbach's $\alpha = .79$).

Participants
Of the 726 drivers identified by DVLA we successfully contacted 542 drivers (27 were dropped as living too far from the sampling area and one car was observed twice). Of those successfully contacted, 318 agree to take part and were interviewed in their own homes by professionally trained interviewers (59% of those contacted). The final sample consisted of 170 males and 148 females aged between 17 and 86 years.

Questionnaire measures
The questionnaire administered during the interview was, like Study 1, based on a scenario methodology used in previous studies (Parker et al., 1992b, 1995). Each scenario minimized contextual details but broadly matched the roads on which observations had been made and included a photograph of the relevant road (e.g. ‘You are driving at 40 mph on a urban road with shops and houses on either side, and a 30 mph speed limit’).

Demographic and driving measures
The following demographic variables were measured: age, gender ($1 = \text{male}, 2 = \text{female}$). We also assessed several driving measures: number of years driving license held (experience), annual mileage (in thousands of miles), and number of accidents over the last three years (converted to an average for a year).

The following measures were operationalized in relation to speeding for each single-carriageway road scenario: urban road (30 mph posted speed limit), suburban road (40 mph posted speed limit), and rural road (60 mph posted speed limit). These were combined to give overall measures in relation to speeding.

Intention to speed
This was assessed using four items (e.g. ‘How strong is your intention to exceed the 30 mph speed limit on this sort of road in your future driving?’ , very weak–very strong,
scored $-3$ to $+3$). The mean of these four items produced a composite scale for each of the four questionnaires (Urban, Cronbach’s $\alpha = .82$; Suburban, $\alpha = .86$; Rural, $\alpha = .89$; Overall, $\alpha = .92$) with higher scores indicating greater intentions to speed.

**Attitudes to speeding**
This was assessed by four semantic differential scales following the statement ‘My driving down this sort of road at 40 mph would be . . . ’, very dangerous–very safe, very irresponsible–very responsible, very stupid–very sensible, very unpleasant–very pleasant). Factor analysis revealed a single factor and so the mean of the items (all scored $-3$ to $+3$) produced a composite scale for each of the behaviours (Urban, Cronbach’s $\alpha = .91$; Suburban, $\alpha = .91$; Rural, $\alpha = .92$; Overall, $\alpha = .93$) such that higher scores indicate more positive attitudes to speeding.

**Subjective norms to speed**
This was measured using two items (e.g. ‘There are some people who are important to me who would think I should drive down this road as 40 mph, disagree strongly–agree strongly, scored $-3$ to $+3$). The reliabilities of the two items were low and therefore only the reported item was employed (Overall, Cronbach’s $\alpha = .72$). Higher scores reflected subjective norms that were more in favour of speeding.

**Perceived behavioural control over speeding**
PBC was assessed using three items (e.g. ‘I would find refraining from driving down this road at 40 mph . . .’, very difficult–very easy, scored $+1$ to $+7$). The reliabilities of the three items were low and therefore one item was dropped (‘Whether or not I drive down this road at 40 mph is mainly up to me’, disagree strongly–agree strongly). The mean of the remaining two items produced a composite scale for each of the behaviours (Urban, Cronbach’s $\alpha = .60$; Suburban, $\alpha = .60$; Rural, $\alpha = .63$; Overall, $\alpha = .77$). Higher scores reflected greater perceptions of control over speeding.

**Moral norm to not speed**
This was assessed using two 7-point items (e.g. ‘It would be quite wrong for me to drive down this road at 40 mph, disagree strongly–agree strongly, scored $+1$ to $+7$). Higher scores reflected moral norms not to speed (Urban, Cronbach’s $\alpha = .71$; Suburban, $\alpha = .60$; Rural, $\alpha = .65$; Overall, $\alpha = .82$).

**Anticipated regret over speeding**
This was measured as the mean of two 7-point items (e.g. ‘If I drove down this road at 40 mph I would feel bad afterwards’, disagree strongly–agree strongly, scored $+1$ to $+7$). The reliabilities of the two items were low and therefore only the reported item was employed (Overall, Cronbach’s $\alpha = .82$). Higher scores reflected greater feelings of anticipated regret about speeding.

**Past speeding behaviour**
This was tapped by four 7-point items (e.g. ‘In your current everyday driving, how often, if at all, do you exceed the 30 mph speed limit on this sort of road? Would you say it was . . .’; never–almost always, scored $+1$ to $+7$). The mean of these four items provided
a composite scale (Urban, Cronbach’s $\alpha = .78$; Suburban, $\alpha = .77$; Rural, $\alpha = .82$; Overall, $\alpha = .90$) with higher scores indicating more frequent previous speeding.

Results

Descriptive statistics and correlations

In Table 1 (below diagonal) means, standard deviations, and zero-order correlation coefficients for all measures are reported. The sample had a mean age of 48 years and had held a driving licence for a mean of 31 years. They drove a mean of 14,000 miles per year and had had a mean of 0.1 accidents per year (over the past 3 years). On average, the sample had slightly negative intentions and attitudes towards speeding and perceived subjective norms not to speed. They also reported relatively low PBC over speeding and reported relatively frequent speeding in the past. The sample also, on average, reported high moral norms not to speed and anticipated regret concerning speeding at the mid-point on the scale. Finally, the objective data indicated that on average their speed across the three road situations was 43 mph.

Examination of the zero-order correlations indicated that from the demographic variables age and experience were significantly negatively related to self-reported previous speeding, intentions to speed and objectively assessed speeding behaviour. Gender was significantly negatively related to self-reported previous speeding and intentions to speed (men were more likely to self-report and intend to speed). Annual mileage was significantly positively related to self-reported previous speeding and intentions to speed. Consistent with the TPB, attitude, subjective norms, and PBC were significantly positively correlated with intentions, while intentions and PBC were significantly positively correlated with behaviour (as was attitudes). Past behaviour was significantly positively correlated with intentions and behaviour. Finally, moral norm and anticipated regret were significantly negatively correlated with intentions and behaviour.

Prediction of intentions to speed

Hierarchical regression analysis was used to assess the impact of our various measures on intentions to speed. Identically to Study 1, at a first step the demographic variables were entered followed at step 2 by the TPB variables of attitude, subjective norms and PBC. At a final step the additional variable of moral norms, anticipated regret and past behaviour were entered (Table 4). The results indicated that the demographic variables accounted for a statistically significant proportion of the variance in intentions ($R^2 = .17$, $F(5, 297) = 12.26$, $p < .001$). Examination of the beta weights indicated gender and age each to have significant negative beta weights while mileage had a significant positive beta weight, with age providing the strongest predictions. Entry of the TPB variables at step 2 resulted in a substantial and statistically significant increment in the explained variance ($R^2_{\text{change}} = .46$, $F(3, 294) = 123.25$, $p < .001$). Examination of the beta weights indicated attitudes and PBC each to have significant positive beta weights, with attitudes providing the strongest predictions. Subjective norms was significant but negative; this is likely to be a statistical artifact given that subjective norms and intentions show a significant, positive, zero-order correlation. Of the demographic variables gender and age remained significant. At step 3, entry of the additional variables resulted in a further statistically significant increment in the explained variance ($R^2_{\text{change}} = .14$, $F(3, 291) = 58.80$, $p < .001$). Examination of the beta weights indicated moral norms and anticipated regret to have significant
negative beta weights and past behaviour to have a significant positive beta weight. Attitudes were significant at this step while the demographic variables became non-significant. Past behaviour provided the strongest prediction. As in Study 1 we re-ran the regression only including the significant predictors and examined the squared semi-partial correlation coefficients to assess the unique variance associated with each predictor. In this equation 76% of the variance in intentions was explained with approximately 18% attributable to unique and 58% common variance effects (Unique variances: past behaviour 13%, anticipated regret 2%, attitude 2%, moral norm 1%).

**Table 4.** Predictions of speeding intentions in Study 2 ($N = 303$)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictors</th>
<th>$R^2$</th>
<th>$R^2_{change}$</th>
<th>$F_{change}$</th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
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<td>-.04</td>
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<td>-.26***</td>
<td>.07</td>
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<td>.04</td>
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<tr>
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<td>.05</td>
<td>.00</td>
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</tr>
<tr>
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<td>.01</td>
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<tr>
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<tr>
<td></td>
<td>Past speeding behaviour</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**Prediction of speeding behaviour**

Hierarchical regression analysis was also used to assess the impact of demographic and TPB variables on speeding behaviour as measured via the infra-red camera. As for Study 1, at a first step the demographic variables were entered followed by the TPB variables of intentions and PBC at step 2. At a third step the TPB variables of attitude and subjective norms were entered consistent with the TPB. At a final step the additional variables of moral norms, anticipated regret and past behaviour were entered (Table 5). The results indicated that the demographic variables accounted for a statistically significant proportion of the variance in behaviour ($R^2 = .07$, $F(5, 297) = 4.63$, $p < .001$), although examination of the beta weights indicated that age was marginally significantly related to speeding ($\beta = -.23$, $p < .06$). Entry of the TPB variables at step 2 resulted in a statistically significant increment in the explained variance ($R^2_{change} = .12$, $F(2, 295) = 22.32$, $p < .001$). Examination of the beta weights indicated intention, but not PBC, to have significant positive beta weights, with no other variables significant. Entry of the remaining TPB variables at step 3 did not result in a statistically significant increment in the explained variance ($R^2_{change} = .00$, $F(2, 293) = .15$, ns). Examination of the beta weights indicated that only intentions had a significant beta weight at this step. At step 4, entry of the additional variables did not result in a statistically significant increment in the explained variance ($R^2_{change} = .01$, $F(3, 290) = 1.42$, ns). However, examination of the final beta weights indicated moral norms to have a significant negative beta weight. Anticipated regret and past behaviour were non-significant. Intentions
remained significant at this step. PBC was significant but negative at this step and this is likely to be a statistical artifact given that PBC and speeding show a significant positive zero-order correlation. As in Study 1 we re-ran the regression only including the significant predictors and examined the squared semi-partial correlation coefficients to assess the unique variance associated with each predictor. In this equation 17% of the variance in behaviour was explained with approximately 7% attributable to unique and 10% common variance effects (Unique variances: intentions 6%, moral norm 0.5%). These results for behaviour were not substantively changed by employing a measure based on whether the speed limit was being broken or not in each differing posted speed zone, with intentions and moral norms emerging as the only significant predictors.

### Table 5. Predictions of speeding behaviour in Study 2 (N = 303)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictors</th>
<th>( R^2 )</th>
<th>( R_{change}^2 )</th>
<th>( F_{change} )</th>
<th>( \beta )</th>
<th>( \beta )</th>
<th>( \beta )</th>
<th>( \beta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gender</td>
<td>.07</td>
<td>.07</td>
<td>4.63***</td>
<td>-.11</td>
<td>-.04</td>
<td>-.04</td>
<td>-.05</td>
</tr>
<tr>
<td></td>
<td>Age</td>
<td>.23</td>
<td>-.07</td>
<td>-.08</td>
<td>-.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Experience</td>
<td>-.04</td>
<td>-.09</td>
<td>-.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Annual mileage</td>
<td>.05</td>
<td>.10</td>
<td>-.10</td>
<td>-.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accidents</td>
<td>.01</td>
<td>.00</td>
<td>-.01</td>
<td>-.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Intentions</td>
<td>.19</td>
<td>.12</td>
<td>22.32***</td>
<td>.39**</td>
<td>.39***</td>
<td>.35**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PBC</td>
<td>.01</td>
<td>.00</td>
<td>-.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Attitudes</td>
<td>.20</td>
<td>.00</td>
<td>0.15</td>
<td>.00</td>
<td>-.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subjective norms</td>
<td>-.03</td>
<td>-.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Moral norms</td>
<td>.21</td>
<td>.01</td>
<td>1.42</td>
<td>-.21*</td>
<td>.06</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anticipated regret</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Past behaviour</td>
<td>.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

### Discussion

The results for Study 2 were consistent with Study 1. Attitudes, moral norms, anticipated regret, and past behaviour predicted individuals’ intentions to exceed the posted speed limit by 10 or more miles per hour explaining 76% of the variance. Intentions and moral norms predicted individual’s speeding behaviour on the road explaining 17% of the variance. Again, there was no impact of demographic variables on intentions or behaviour after controlling for TPB and additional variables. Also similar to Study 1, although past behaviour showed a significant unmediated impact on intentions there was no such effect on speeding behaviour.

One criticism of Study 2 is the use of a measure of average speed rather than percentage time speeding, which would show a better correspondence to the other measures. Unfortunately a measure of speeding similar to that used in Study 1 was not available for Study 2 because of the way in which the data was collected. However, the use of a measure based on whether the speed limit was being broken or not in each differing posted speed zone produced substantively identical results with intentions and moral norms emerging as the only significant predictors. In addition, the use of average speed provided a measure with greater variance than one based on whether the speed limit was or was not broken. Finally, the problem of the causal ordering of the cognition...
and behaviour measures in Study 2 mean the findings need to be treated with caution until replicated.

**GENERAL DISCUSSION**

The results from the two studies support and extend previous research on driving based on the Theory of Planned Behaviour (e.g. Parker et al., 1992b). In relation to intentions, in Study 1 attitudes, subjective norms, PBC, moral norms, anticipated regret and past behaviour predicted 82% of the variance in intentions to speed. In Study 2, attitudes, moral norms, anticipated regret and past behaviour predicted 76% of the variance in intentions to speed. Attitudes, moral norms, anticipated regret and past behaviour were consistent predictors of intentions across studies. The role of attitudes in predicting speeding intentions has been consistently reported across a number of studies (e.g. Parker et al., 1992b). The findings for moral norms (Parker et al., 1995), anticipated regret (Parker et al., 1995), and past behaviour (Elliott et al., 2003) also confirm previous findings in the literature on speeding and for other behaviours and suggest that these may be useful additional variables for predicting intentions in the TPB.

In relation to speeding behaviour, in Study 1 intentions, PBC, moral norms and previous accidents predicted 35% of the variance in speeding as assessed on a driving simulator. In Study 2, intentions and moral norms predicted 17% of the variance in speeding as assessed on-road. Intentions and moral norms were consistent predictors of behaviour across studies. Only Elliott et al. (2003, 2007) have previously examined TPB-based predictions of speeding behaviour. Elliott et al. (2003) used a self-report measure of speeding and found intention and past behaviour to predict speeding in addition to PBC, explaining 53% of the variance (including demographic and driving predictors). Elliott et al. (2007) used a simulator measure of speeding similar to the one used in Study 1 here and only intention predicted speeding, explaining between 31 and 35% of the variance. It is interesting to note that, consistent with the meta-analysis of Armitage and Conner (2001) the correlation between intentions and (speeding) behaviour was higher for self-reports (Elliott et al., 2003: $r = .67$; Elliott et al., 2007: $r = .67$ to .76) than for objective assessments of speeding behaviour (Study 1, speeding on the simulator: $r = .48$; Study 2, on-road speeding: $r = .41$; Elliott et al., 2007: $r = .54$ to .62). The consistency in the size of effect across the two studies reported here is remarkable, particularly given the, already noted, complementary characteristics of the two studies. This equates to a medium-to-large effect size of intentions on objectively assessed speeding behaviour (Cohen, 1992) and is comparable to the average effect size across TPB studies reported by Armitage and Conner ($r_p = .47$). Such a finding partly legitimates a focus on intentions as a means of changing speeding behaviour. The consistent effects of moral norms across studies both on intentions and behaviour is also noteworthy and may usefully represent a target for interventions designed to change speeding behaviour (see below). The unmediated impact of accidents on speeding observed in Study 1 may reflect an aspect of previous speeding behaviour not assessed by self-report measures of past behaviour. However, given the inconsistent results for accidents we would not wish to place undue reliance on this finding.

In addition, the consistent lack of effect of past behaviour is worth comment. As noted earlier, past behaviour has been found across a number of studies to be an
important additional predictor of behaviour over and above TPB variables (see Conner & Armitage, 1998). Such data have been used to suggest that frequently performed behaviours, like speeding, may become under habitual rather than intentional control (Ouellette & Wood, 1998). However, other authors (e.g. Ajzen, 2002) have argued that common method variance between self-report measures of past and future behaviour may cause an over-estimate of the impact of past on future behaviour. This may help to explain the differences in findings for the impact of past on future speeding behaviour in the present studies compared to Elliott et al. (2003). In the current studies where the measures did not share such common method variance the size of the relationship between past and future behaviour measures was attenuated (Study 1: $r = .23$; Study 2: $r = .31$; Elliott et al., 2003: $r = .69$) and suggests speeding is a behaviour under the control of intentions rather than being driven by past behaviour (but see Elliott et al., 2003). Nevertheless we must note the difficulties in any simple interpretation of the past behaviour–behaviour effects for Study 2, given the acknowledged problems with the order in which data was collected for this study. In addition, multicollinearity may explain the fact that past behaviour did not explain future behaviour in the presence of other predictor variables in either study.

It is also interesting to note a number of minor inconsistencies between the studies. In relation to predictions of intentions, subjective norm and PBC were only significant independent predictors in Study 1 but not in Study 2. Similarly, PBC was only a significant positive predictor of speeding behaviour in Study 1 but not in Study 2. It may be that these differences are attributable to variations in the intercorrelation of predictor variables across the two studies that are apparent in Table 1, which in turn may be due to variations between the two samples. This would be consistent with the TPB, which suggests that power of constructs to predict intention and behaviour is likely to vary across behaviours and populations studied. Alternatively, and perhaps more likely, the differences between studies may be attributable to variations in the items used to tap constructs. In particular, there were difference between studies in the measures of speeding employed, with percentage time speeding used in Study 1 and mean speed used in Study 2. Although the Study 1 measure showed better correspondence with the predictor variables, the use of mean speed as the dependent variable did not substantively alter the results. 5

It is notable that demographic variables such as gender, age, driving experience, and number of accidents did not consistently add to the prediction of intentions or actual behaviour. Previous work has documented a clear contribution of age and sex to the prediction of intentions. Young males tend to demonstrate a lesser ability to refrain from committing violations, view the outcomes of violations less negatively and feel less control over committing violations (see Lawton et al., 1997b; Parker et al., 1992a, 1992b). The present research suggests that the TPB with additional variables was able to mediate the influence of demographics variables and, as Parker et al. (1992b) point out, previous failed attempts to demonstrate this may have been the result of a ‘failure to assess the model’s components fully or reliably enough’ (p. 100). Alternatively, Boyce and Geller (2002) suggest that males do not take more risks than females, arguing that the gender differences reported in earlier self-report studies (e.g.

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5 In Study 1 use of mean speed as the dependent variable produced comparable results with accidents ($\beta = .18$, $p < .05$), intentions ($\beta = .52$, $p < .01$), and PBC ($\beta = .24$, $p < .05$) all being significant predictors, and moral norms marginally significant ($\beta = .19$, $p < .10$); the full set of variables explained 46.8% of the variance.
Arnett, 1996; Jonah, 1990) are a consequence of measurement error, and social desirability bias. However, the failure to find direct effects of demographic variables on speeding behaviour in the present studies precludes a proper test of such mediation ideas.

**Intervening to change speeding**

The results of the two studies suggest that the TPB offers a good theoretical basis on which to develop road safety campaigns designed to change speeding behaviour. It is concluded that individuals’ propensity to engage in speeding is based upon their intentions to speed and lack of moral norms not to speed. Intentions themselves were based on attitudes, moral norms, anticipated regret and past behaviour. This suggests that attitudes, moral norms and anticipated regret constitute appropriate targets for interventions designed to change speeding behaviour. Attitudes could be changed by targeting underlying salient behavioural beliefs. Such an approach has been taken in other studies with speeding (Parker, 2002; Parker, Stradling, & Manstead, 1996) and other behaviours (see Conner & Sparks, 2005; Hardeman et al., 2002). Less research has targeted moral norms or anticipated regret in order to change behaviour. However, increasing the salience of such constructs may be one way to produce behaviour change (e.g. Abraham & Sheeran, 2003; Richard et al., 1996b). Further studies of interventions that target such variables and observe effects on intentions and observed driving behaviour are clearly required.

The effect of past behaviour on intention to speed presents a difficult problem. If a behaviour comes under the control of automatic processes it seems reasonable to suppose that such behaviour is much more resistant to behavioural change. The possibility of physical interventions to ‘break the habit’ of speeding is receiving a great deal of attention in the field of intelligent transport systems (Besseling & van Boxtel, 2001; Comte, 2000; Váhelyi & Mäkinen, 2001) and the effect of such upon individuals’ intentions to speed may provide interesting future research. However, in the present studies past behaviour did not have an unmediated impact on speeding behaviour. This is important because it points to the potential power of interventions targeted at speeding intentions to change speeding behaviour.

**Conclusions**

The present research provides strong support for the application of the TPB to understanding objectively assessed speeding behaviour across two studies employing different measures of behaviour to speeding across different road types with varying posted speed limits. The additional variables of moral norms, anticipated regret and past behaviour were shown to add consistently to predictions of intentions to speed. Intentions and moral norms were shown consistently to predict objectively assessed

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6 In the present research we noted differences in relation to young (< 25 years of age) male drivers when compared to all other respondents. Although intentions showed a similar power to predict speeding behaviour across groups, PBC was a significantly stronger predictor of speeding behaviour in young males compared to other groups (Study 1: p < .01; Study 2: p < .01).

7 In Study 2 we also obtained measures of modally salient behavioural beliefs. Three beliefs consistently distinguished those who intended to speed from those who did not across the three scenarios: believing that speeding would get you to your destination more quickly; believing that speeding would increase the chances of an accident; believing that speeding would get you stopped by the police (ps < .001). These might form appropriate targets for an intervention designed to change speeding attitudes.
speeding behaviour. With the development of on-board instrumentation tapping speed, linked to systems to locate a car on specific road governed by a particular speed limit, the possibility of future research testing the power of the TPB to predict speeding in truly prospective designs has become more feasible. However, we should not underestimate the difficulties of conducting such research with appropriate sample sizes (Carsten, 2002; Várhegyi, 2002). Future research should also address the extent to which manipulation of the variables identified here produces changes in objectively assessed speeding behaviour.

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