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Applications of the theory of planned behaviour to drivers' speeding behaviour

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Abstract

The theory of planned behaviour (TPB; Ajzen, 1985, 1988, 1991) provides a potentially useful approach for investigating the links between drivers' attitudes and behaviour and for informing road safety interventions that aim to promote 'safe' driving. This paper presents a review of previous research studies in which the TPB has been applied to drivers' speeding behaviour. Some conceptual and methodological limitations of the studies are raised. We then summarise two studies that we have recently conducted to overcome these limitations and discuss the implications for road safety.

Introduction

It is well-known that excessive driving speed is one of the most important contributory factors in road traffic accidents. The relationship between driving speed and accident liability is complex (Taylor, 2001). However, research has demonstrated convincingly that fast driving will increase the likelihood of a driver being involved in an accident (Finch, Kompfner, Lockwood and Maycock, 1994; Taylor, Lynam and Baruya, 2000). Furthermore, when an accident does occur, its severity will tend to increase with vehicle speed. As well as the safety concerns of fast driving, Ward (1999) described a number of other disbenefits including: (1) increased exhaust emissions which leads to poor air quality, and the emission of carbon dioxide which contributes to global warming, (2) increased noise and vibration, (3) damage to property and death and injury to animals, and (4) reduced social interaction between members of the community and the severance of

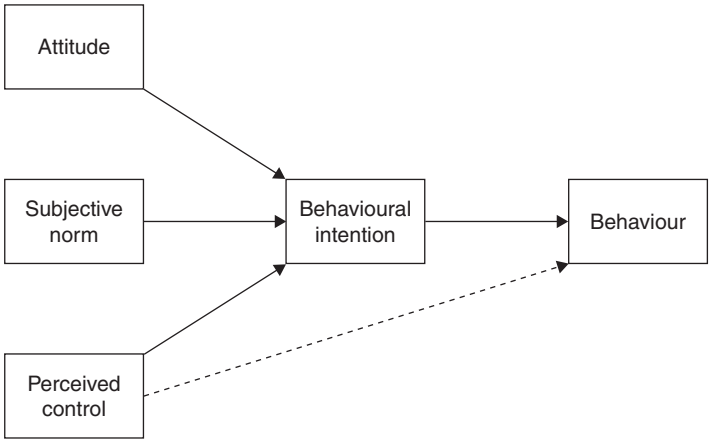
communities from shops and facilities, and from other parts of the community. Excessive speed, however, which typically involves exceeding the speed limit, is not a rare occurrence (e.g. Corbett & Simon, 1992; Department for Transport, 2002). Considerable benefits to road safety and society in general are likely to be found by persuading drivers to comply with legal speed limits.

The effects of demographic variables on drivers' behaviour are well documented (e.g. French, West, Elander and Wilding, 1993; Meadows and Stradling, 2000; Quimby, Maycock, Palmer and Buttress, 1999a; Stradling, 2000). Older drivers, female drivers and lower mileage drivers, for example, have been found to drive more slowly and to comply with speed limits more often than younger drivers, male drivers and higher mileage drivers. However, this information is of limited use when developing road safety interventions to promote compliance with speed limits. To develop effective interventions, what we need to know is: why do drivers of different ages, for example, behave differently? In other words, we need to identify variables that can explain the demographic — behaviour relationships. These variables also need to be predictive of behaviour and amenable to change via road safety interventions. A suitable approach for identifying such variables is found in the theory of planned behaviour (TPB; Ajzen, 1985, 1988, 1991).

The theory of planned behaviour

The TPB provides one of the most influential accounts of the relationship between attitudes and behaviour. The model (see Figure 1) postulates that behaviour is determined independently by two variables: intention, which is a summary of people's motivation to perform a given behaviour, and perceived control, which is people's perception of their ability to perform the behaviour. Intentions are, in turn, determined independently by three variables: attitude towards the behaviour (people's positive or negative evaluations about their performing the behaviour), subjective norm (people's perceptions of approval or disapproval from significant others for performing the behaviour) and perceived control. The effects on behaviour of variables external to the TPB (e.g. demographics) are held to be mediated by the components of the model.

Figure 1 **Theory of Planned Behaviour**



From an applied perspective, it is important to demonstrate the relationships posited by the TPB because if TPB variables cannot predict intentions and behaviour then, in the context of this paper, it would suggest that road safety interventions to alter drivers' attitudes would be ineffective in promoting compliance with speed limits[1].

Numerous studies have provided support for the TPB as a general theory of social behaviour (for reviews see Ajzen, 1988, 1991; Armitage and Conner, 2001). In the domain of traffic psychology the theory has been used to investigate a number of driving behaviours (for a review see Manstead and Parker, 1995). Much of the research on applying the TPB to driving behaviour was conducted under Road Safety Division's (RSDs) Behavioural Studies Programme and it led to a better understanding of why certain behaviours are carried out and how they might be changed to improve road safety. The following sections of this paper focus on previous applications of the TPB to speeding violations specifically.

Evidence for the TPB — intention relationship

The relationships between the TPB variables and drivers' intentions to speed have been demonstrated convincingly. Parker, Manstead, Stradling, Reason and Baxter (1992) conducted one of the first studies in which the TPB was applied to drivers' speeding behaviour. They conducted a survey of 881 drivers and investigated intentions to exceed the speed limit by 10mph in a 30mph zone. It was found that attitude, subjective norm and perceived control together accounted for 47% of the variance in intentions to speed and all three independent variables were statistically significant independent predictors of intention.

Parker (1997) later conducted a survey of 318 drivers and demonstrated that the results of the earlier study generalised to speeding intentions in three different contexts. Attitude, subjective norm and perceived control together accounted for between 47% and 56% of the variance in intentions to exceed the speed limit by 10mph in 30mph, 40mph and 60mph zones.

More recent studies have supported the previous findings of Parker and colleagues. For example, Stead, MacKintosh, Tagg and Eadie (2002) conducted four TPB surveys over a period of three years to monitor changes in drivers' attitudes, intentions and self-reported speeding behaviour in 30mph zones due to the Scottish 'Foolsspeed' campaign (a campaign based on the TPB designed to change drivers' attitudes and speeding behaviour). Across the four surveys, the TPB was found to account for between 47% and 53% of the variance in intentions to speed. In all but

[1] The TPB is a causal model of behaviour in that attitudes, subjective norms and perceived control have a causal effect on intentions, and intentions have a causal effect on behaviour. These cause and effect relationships are essential to the idea that changes in behaviour can be brought about by changes in attitude. Establishing the causality of the relationships is difficult. However, it should be noted that previous studies using cross lag correlation analyses and variants of structural equation modelling provide some evidence for the posited cause and effect relationships, and they suggest that the effects of attitudes on behaviour are stronger than are the effects of behaviour on attitudes (e.g. Armitage and Conner, 1999; Bentler and Speckart, 1981; Kahle and Berman, 1979).

one survey, attitudes, subjective norms and perceived control were each significant predictors of intentions. In the other survey, subjective norm was not a significant predictor.

Evidence for the TPB — behaviour relationship

There have been few studies that have tested the ability of the TPB to predict speeding *behaviour*. In both the Parker (1997) and the Stead *et al.* (2002) studies referred to above, cross-sectional designs were used to obtain measures of TPB variables and self-reported behaviour. In both studies, the TPB was found to be a strong predictor of reported behaviour. The Parker (1997) study showed that, across 30mph, 40mph and 60mph roads, the TPB accounted for between 56% and 63% of the variance in self-reported speeding behaviour. In the Stead *et al.* (2002) study, the TPB accounted for between 33% and 40% of the variance in reported speeding on 30mph roads.

In addition to investigating the predictive validity of the TPB with respect to a self-reported measure of speeding behaviour, Parker (1997) tested the TPB's ability to predict observed driving speeds using a retrospective design. The speeds of 726 drivers were recorded on one of four roads, each of which included sections with 30mph, 40mph and 60mph speed limits. Spot speeds of each driver were recorded on each of the three sections. The TPB measures were obtained from 318 of the drivers subsequently by conducting interviews in participants' homes. Regression models showed that the TPB accounted for between 10 and 11% of the variance in observed driving speeds and intention to speed was the only statistically significant independent predictor of observed behaviour.

Limitations of previous research

Although the research we have reviewed provides results that are indicative of a relationship between the TPB variables and speeding behaviour, there are a number of conceptual and methodological limitations of prior research. These are briefly summarised below:

1. In both the Parker (1997) and Stead *et al.* (2002) studies, cross-sectional and/or retrospective designs were used. Cross-sectional and retrospective designs have potential limitations stemming from the fact that the behaviour measures obtained may only be regarded as measures of past behaviour. The use of past behaviour as a dependent variable is potentially problematic because it breaches the assumed causal ordering within the TPB (e.g. that the relationship between intention and behaviour is a cause and effect one) and past behaviour is known to affect subsequently reported attitudes (e.g. Bem, 1972; Salancik and Conway, 1975).

2. Cross-sectional designs also render the data vulnerable to consistency biases (see Budd, 1987), which are likely to artificially inflate the correspondence between components (e.g. intentions and behaviour). It is likely that consistency biases will pose a significant problem when behaviour is self-reported and measured within the same questionnaire as the TPB variables. Prospective designs with a time gap between the TPB and behaviour measures are less vulnerable to these criticisms[2].

3. Self-report is widely recognised as a valuable methodology in social research and reasonably strong correlations can be found between self-reported and more objective measures of behaviour (e.g. Aberg, Larsen, Glad and Beilinsson, 1997; De Waard and Rooijers, 1994; West, French, Kemp and Elander, 1993). However, self-reported measures of behaviour are vulnerable to social desirability and memory biases, both of which can lead to under — or over-estimates of how frequently behaviour is performed (see Corbett, 2001). Thus, drivers' self-reports may not provide entirely accurate accounts of their speeding behaviour.

4. Although Parker (1997) used more objective measures of behaviour in addition to self-report, a potentially important limitation of the study was that drivers' speeds were measured once at one specific location. A number of studies have found that 'spot speed' measures can have limited reliability (e.g. Haglund and Aberg, 2002; Ogawa, Fisher and Oppenlander, 1962; Quimby, Maycock, Palmer and Grayson, 1999b; Wasielewski, 1984). In the Parker (1997) study, the use of spot speed measures may therefore have limited the ability of the TPB to predict drivers' speeding behaviour.

In order to provide an appropriate test of whether the TPB can predict drivers' speeding behaviour, and thus determine whether interventions based on the model have the potential to be effective, it appears that there is a need for studies that: (1) are prospective in design, and (2) use more objective measures of behaviour than self-report — measures that are both reliable and valid indices of speeding behaviour. To address the first requirement, we have recently conducted a large scale prospective survey in which TPB variables, measured at time one, were used to predict a measure of self-reported compliance with speed limits, measured three months later. Since that study was still vulnerable to the criticisms of self-reported behaviour data, we conducted a second study in which the TPB was used to predict a more objective measure of speeding behaviour, which was obtained using a driving simulator. These two studies are summarised in the following sections of this report.

[2] It should be noted that as well as testing the TPB's relationships using a cross-sectional design, Stead *et al.* (2002) also tested whether TPB variables measured at time one (baseline) could predict self-reported speeding intentions and behaviour measured three years later (their fourth survey point). Together with demographic variables, the TPB accounted for a modest amount of variance only in subsequently measured intentions (27%) and behaviour (21%), and the effect of age appeared to be accounting for the majority of the variance. However, one could question whether this was a valid test of the TPB's ability to predict prospectively measured behaviour because the main purpose of the Stead *et al.* (2002) study was to evaluate the effectiveness of a large scale campaign designed to change drivers' attitudes (and subjective norms and perceived control), intentions and behaviour. This campaign ran during the period between the measurement of the TPB variables at baseline and the behaviour variables three years later. It might be unreasonable to suggest that the TPB can provide a strong account of behaviour when intervening steps are taken to change attitudes over a long period of time between the baseline and subsequent measures. Furthermore, the relationship between age and attitudes/behaviour is well documented (e.g. Parker, Manstead, Stradling and Reason, 1992; Quimby *et al.,* 1999a) suggesting that attitudes and behaviour change over time. This is likely to affect the level of correspondence between TPB and behaviour variables when the time gap between the measures is as long as three years.

A prospective self-report survey of drivers' speeding behaviour

In our first study, we used the TPB as a framework to investigate a number of issues regarding drivers' compliance with speed limits while driving in built-up areas (Elliott, Armitage and Baughan, 2003). In this report we focus only on those aspects of the study that related to the prediction of intentions and behaviour from TPB variables, and the mediation of the effects of demographic variables. The study was a prospective self-completion postal survey. At time one, TPB variables with respect to complying with the speed limit over the next three months were measured using standard questionnaire items. The demographic variables of age, sex, mileage and socio-economic group (SEG) were also measured at time one. Three months later, follow up questionnaires were sent to respondents to measure their reported compliance with speed limits since their completion of the time one questionnaires. Almost 600 drivers completed questionnaires at both time intervals.

Using regression analysis we found further support for the TPB as a predictor of drivers' speeding intentions. Attitude, subjective norm and perceived control accounted for 48% of unique variance in drivers' intentions to comply with the speed limit and all three independent variables were significant predictors. More importantly we were able to demonstrate that the TPB was a powerful predictor of prospectively measured self-reported compliance with speed limits. A hierarchical regression analysis, in which the prospective measure of reported speeding behaviour was regressed on the demographic variables in step one and the TPB variables in step two, showed that the demographic variables accounted for 17% of the variance in behaviour ($p < .001$). When the TPB variables were added to the analysis they led to an increase in explained variance of 32 percentage points ($p < .001$). In line with the TPB, intention and perceived control were the significant independent predictors ($p < .001$ in each case). They were more powerful predictors of behaviour than were the demographic variables, as indicated by the final standardised beta weights from the analysis. After we took the TPB variables into account the predictive validity of the demographic variables decreased, suggesting that their effect on behaviour had been mediated by the TPB. Using the test for establishing mediator effects suggested by Edwards (1984), we were able to demonstrate that the predictive validity of age and sex decreased significantly ($p < .01$ and $p < .05$, respectively). However, we did not find that the predictive validity of SEG decreased by a statistically significant amount. Variables that are outside the scope of the TPB (e.g. moral norm or personal identity) have been found to predict drivers' speeding behaviour (e.g. Manstead and Parker, 1996) and such variables may be required to explain the SEG-behaviour relationship.

In summary, the results provided by this first study demonstrated convincingly that the TPB was a strong predictor of self-reported speeding behaviour. The findings were particularly encouraging given that a prospective design rather than a cross-sectional or retrospective design was used. This meant that the conceptual limitations of previous research (see above) were overcome and the three month time gap between the TPB and behaviour measures being taken was likely to reduce any consistency bias in the data.

A study testing the predictive validity of the TPB using an observed measure of speeding behaviour

As we have described, a potential limitation of our first study was that the behaviour measure was self-reported. Therefore, in our second study (Elliott, Armitage and Baughan, forthcoming) we wanted to test whether the TPB could predict a more objective speeding behaviour measure, which we obtained using the TRL driving simulator. We used a driving simulator because it provided a safe and controlled environment in which to conduct the research (Kaptein, Theeuwes and van der Horst, 1996) and it offered a useful method for obtaining reliable measures of speeding behaviour.

The study used a prospective design. 74 participants completed questionnaires containing standard measures of TPB variables with respect to avoiding/exceeding the speed limit over the next week, and measures of the demographic variables age, sex and mileage. One week later, the participants drove in the TRL driving simulator. Speeding on a number of different road types was investigated in the study. For the purposes of this paper only those results relating to urban distributor roads will be discussed, although it should be noted that consistent results were obtained across all road types. The simulated urban distributor route was 5km in length with a 30mph speed limit. Driving speed data obtained from the simulator was used to calculate the proportion of the distance of the drive that each participant exceeded the speed limit by 10% (i.e. the proportion of the distance that they were driving in excess of 33mph).

In line with previous research, multiple regression showed that attitude, subjective norm and perceived control were each statistically significant independent predictors of intention to avoid exceeding the speed limit. For the purposes of this paper, we included demographic variables in the analysis where the TPB was used to predict behaviour (i.e. we replicated the analysis procedure used in study one whereby the behaviour variable was regressed on the demographic variables in step one and the TPB variables in step two). Remarkably similar results to those we obtained in our first study were found in this study. The demographic variables accounted for 19% of the variance in observed behaviour ($p < .01$). The TPB variables added a substantial amount to explained variance over and above that accounted for by the demographics (an increase of 24 percentage points, $p < .001$). Of the TPB variables, intention was the only statistically significant independent predictor of observed speeding behaviour ($p < .001$). This pattern of findings is consistent with Parker (1997). However, in our research the TPB was found to account for much more variance in observed behaviour than in the Parker (1997) study, possibly because the measure of speeding behaviour was more reliable as it was based on driving over a whole length of road rather than a 'snapshot' of behaviour at one point in time.

Age was the only demographic variable to have a statistically significant effect on observed speeding behaviour in step one of the analysis. After the TPB variables

were taken into account, its ability to predict behaviour decreased. Although this suggested that the TPB mediated the age-observed behaviour relationship, the decrease in predictive validity was not found to be statistically significant. However, intention to comply with the speed limit was a much stronger predictor of behaviour than age was.

Although the validity of this study could be criticised on the grounds that a driving simulator was used to measure speeding behaviour, we are confident in the validity of the findings for a number of reasons. One reason is that intention was the sole independent TPB predictor of behaviour, and this finding is consistent with Parker (1997). Another is that the mean speeds observed on the simulator in this study (not reported here) are comparable with mean speeds observed on urban roads in 'real life', which are reported in transport statistics (Department for Transport, 2002). This is supported by validation studies of the TRL driving simulator which have shown that the correspondence between mean speeds on the simulator and mean speeds in 'real life' are broadly comparable (see Lockwood, 1997). In addition, the finding that the TPB was a strong predictor of observed behaviour in the simulator supports both the TPB and the validity of the driving simulator. In effect, this is a form of construct validation in which the behaviour of a measured variable in accordance with theory is taken as simultaneously supporting both the theory and the validity of the variable as a measurement of the underlying construct (in this case, real-world speed behaviour) that it is aiming to tap.

Road safety implications

As we have outlined, the inherent usefulness of the TPB is that it can be used to identify variables to target in road safety interventions. The idea is that if attitudes (and subjective norms and perceived control) can predict drivers' intentions to speed, and intentions can in turn predict speeding behaviour, then changing drivers' attitudes, making them more desirable from a road safety perspective, is likely to bring about corresponding changes in intentions and behaviour. There is strong evidence for this argument. It has been demonstrated convincingly that attitudes (and subjective norms and perceived control) can predict drivers' intentions to speed. Prior studies have produced findings that are indicative of a TPB-speeding behaviour relationship (e.g. Parker, 1997; Stead *et al.*, 2002). Our research in which we have attempted to overcome some of the limitations of previous studies, lends further support to the TPB-speeding behaviour relationship. Thus, the accumulated research shows that there is strong support for the TPB's application to drivers' speeding behaviour.

Despite this, previous attempts to modify drivers' attitudes have been found to produce little systematic change in intentions and behaviour (e.g. Parker *et al.*, 1996; Meadows and Stradling, 1999; Stead *et al.*, 2002). However, it should be noted that long-term attitude change is notoriously difficult to achieve (Cook and Flay, 1978). It might be the case that in previous empirical investigations, the *techniques* used to change drivers' attitudes have been ineffective, producing only small changes over time which might not be sufficient to change driving behaviour. Indeed, some previous evaluations have taken place in laboratory situations (e.g. Parker *et al.*, 1996), which may be regarded as artificial and not conducive to bringing about

changes in real world attitudes. Others have used extremely small sample sizes (e.g. Meadows and Stradling, 1999), which lead to low statistical power. In addition, the literature on attitude change has shown that repeated exposure to a persuasive argument will enhance its persuasive effect so long as a number of criteria are met such as having a high-quality argument (e.g. Cacioppo and Petty, 1979, 1985). However, in most studies of driver attitude change interventions, participants have been exposed to the intervention on one or two occasions only. There is also an abundance of studies in the attitude change literature showing that persuasion is likely to be enhanced when individuals have the ability and are motivated to engage in issue relevant thinking (see Eagly and Chaiken, 1993). This is likely to lead to changes in the cognitive structure underpinning attitudes, and in terms of Petty and Cacioppo's (1986) 'Elaboration Likelihood Model' this is called 'central route persuasion'. Attitude change that is not accompanied by a change in underlying cognitions (referred to as 'peripheral route persuasion') may only be temporary, is likely to be affected by peer group pressure and other influences, and is unlikely to be predictive of behaviour. Media advertising (Stead *et al.*, 2002) or video interventions (e.g. Parker *et al.*, 1996) may not be sufficient to bring about central route changes in attitudes; interventions that require more active involvement from the participants may be more effective in bringing about attitude change that is relatively enduring, resistant and predictive of behaviour. Though further research may be required to develop such countermeasures, it is possible that classroom-based interventions that allow a high level of interaction between 'student' and 'teacher', or interactive computer-based interventions, would have the required prerequisites.

In general, further research is required to investigate effective ways of changing drivers' attitudes to speeding, their intentions to speed and ultimately their speeding behaviour. Studies in which interventions are administered in the real world (perhaps in the context of driver training) and evaluated using adequate sample sizes are required.

Conclusions

1. Excessive driving speed is a problem for road safety and effective interventions to promote compliance with speed limits are required. The theory of planned behaviour offers a useful approach for identifying variables that (a) predict drivers' speeding behaviour, (b) can explain the relationships between demographic variables and behaviour and (c) are potentially amenable to change via road safety countermeasures.

2. Previous research has demonstrated convincingly that the TPB can predict intentions to speed. However, previous studies in which the link between TPB variables and speeding behaviour has been tested have used cross-sectional or retrospective designs, which are associated with a number of potential limitations stemming from the fact that the behaviour measures are past rather than future behaviour. Cross-sectional designs are also vulnerable to consistency biases that may artificially inflate the correspondence between TPB and behaviour measures. In addition, there are few studies in which speeding behaviour has been measured more objectively than self-report.

3. Our recent work, summarised in this report, has demonstrated that the TPB can predict speeding behaviour when using prospective designs, which are less vulnerable to the criticisms described above. We have also demonstrated that the TPB can provide a good account of measures of behaviour that are more objective than self-report (i.e. observed speeding behaviour as measured in a driving simulator). In both our studies, the TPB variables were more powerful predictors of speeding behaviour than were the demographic variables and we also found evidence to suggest that the effects of demographic variables on behaviour were *mostly* explained by the TPB.

4. The accumulated research evidence, therefore, supports the notion that it should be possible to promote compliance with speed limits by changing drivers' attitudes and intentions to speed.

5. Previous studies have not convincingly demonstrated an impact of attitude change interventions on drivers' attitudes to speed, their speeding intentions or their speeding behaviour. However, there are a number of limitations of previous evaluation studies that need to be borne in mind, including the use of small sample sizes and laboratory, as opposed to 'real world', situations.

6. Ideally, interventions are needed that require more active involvement from the participant than is required in traditional forms of media advertising (e.g. posters and television adverts). Classroom-based interventions that allow a high level of interaction between 'student' and 'teacher', or interactive computer-based interventions, may be successful in engineering attitudes that are long lasting, resistant to change and predictive of behaviour. It would be desirable to evaluate such interventions in the context of driver training programmes.

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