Running head: DRIVERS' COMPLIANCE WITH SPEED LIMITS

Drivers' Compliance with Speed Limits: An Application of the Theory of Planned Behavior

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Abstract

The theory of planned behavior (TPB) was applied to drivers' compliance with speed limits. Questionnaire data were collected for 598 drivers at two time points separated by three months. TPB variables, demographic information and self-reported prior behavior were measured at time 1 and self-reported subsequent behavior was measured at time 2. In line with the TPB, attitude, subjective norm and perceived control were positively associated with behavioral intention, and intention and perceived control were positively associated with subsequent behavior. TPB variables mediated the effects of age and sex on behavior. Prior behavior was found to moderate the perceived control-intention and perceived control-subsequent behavior relationships. Practical implications of the findings for road safety and possible avenues for further research are discussed.

Drivers' Compliance with Speed Limits: An Application of the Theory of Planned Behavior

Excessive driving speed is a major concern for road safety as it has been found to increase both the frequency and the severity of road traffic accidents (e.g., Finch, Kompfner, Lockwood, & Maycock, 1994; Taylor, Lynam, & Baruya, 2000). Persuading drivers to drive more slowly and, more specifically, to comply with legal speed limits is likely to have considerable benefits for road safety. Researchers have identified a number of key demographic characteristics of drivers who speed. Among these demographic variables are age, sex, mileage and socio-economic group. Younger drivers, male drivers, higher mileage drivers and drivers from higher socio-economic groups have been found to drive faster and exceed speed limits more often than older drivers, female drivers, lower mileage drivers and drivers from lower socio-economic groups (e.g., French, West, Elander, & Wilding, 1993; Meadows & Stradling, 2000; Quimby, Maycock, Palmer, & Buttress, 1999; Stradling, 2000).

Although knowledge about the demographic characteristics of drivers who speed is important (e.g., for targeting remedial action), these variables provide only descriptive information. They do not explain why people do (or do not) comply with speed limits, nor are they readily amenable to change via road safety interventions. As a result, they provide little information about how to influence speeding behavior. The challenge for psychologists is to identify variables that mediate the relationships between the demographic characteristics of drivers and their speeding behavior, namely variables that: (a) explain the relationship between demographics and behavior, (b) are amenable to change, and (c) posses predictive validity. The theoretical approach that is perhaps best suited to addressing this issue is found in the theory of planned behavior (TPB; Ajzen, 1985) because it is posited as a complete model of social behavior. In other words, the effects on behavior of variables external to the TPB (e.g., demographics) are thought to be mediated through the components of the model. One of the aims of the present study was to test whether the effects of demographic variables on drivers' speeding behavior were mediated by the TPB.

The TPB (see Figure 1) posits that behavioral intentions are the main determinants of behavior. Intentions are, in turn, determined independently by attitudes towards the behavior (global positive or negative evaluations about performing the target behavior), subjective norms (perceived social pressure from significant others to engage in the target behavior), and perceived behavioral control (perceptions regarding the ease or difficulty of performing the target behavior). Perceived control is (with intention) also regarded as a codeterminant of behavior, although the perceived control-behavior relationship is dependent on the accuracy of people's perceptions of control (Ajzen, 1991; Sheeran, Trafimow, & Armitage, in press).

Accumulated research has demonstrated strong support for the main tenets of the TPB in a wide variety of behavioral domains (for reviews see Ajzen, 1988, 1991; Armitage & Conner, 2001; Godin & Kok, 1996; Manstead & Parker, 1995). Previous research has also provided empirical support for the TPB's application to speeding behavior in so far that attitudes, subjective norms and perceptions of control are positively associated with intentions to speed (e.g., Forward, 1996; Parker, Manstead, Stradling, Reason, & Baxter, 1992). However, a number of important research questions, that have theoretical implications for the TPB and practical implications for road safety, remain unanswered.

The first question addressed in the present study was, "Can the TPB predict not only drivers' intentions to speed, but also their speeding behavior?" To date, researchers applying the TPB to speeding have adequately assessed the relationships within the model (e.g., Forward, 1996; Parker et al., 1992). As a result, a lot is known about how well the model can predict speeding intentions, yet little is known about how well it can predict speeding behavior. As far as the authors are aware, all previous attempts to assess the predictive validity of the TPB with respect to speeding behavior have used retrospective or cross sectional designs (e.g., Forward, 1996; Manstead & Parker, 1996). However, a criticism of behavior measures which precede or are contemporaneous with TPB measures is that they may only be regarded as a measure of past behavior which is problematic because past

behavior has been shown to independently predict future behavior and is related to the concept of habit (see below). Furthermore, from a methodological point of view, associations between TPB variables and behavior are vulnerable to consistency biases when they are measured at the same point in time and this may result in artificially inflated relationships between TPB measures and behavior (cf., Armitage & Conner, 1999; Budd, 1987). Studies in which behavior is measured prospectively are less vulnerable to these biases because there is a time gap between the TPB and behavior measures. Also, from an applied perspective, it is important to base recommendations for interventions on studies that employ prospective designs and include measures of behavior, given intentions are not an ideal proxy for behavior (Armitage & Conner, 2001). Therefore, in the present study the predictive validity of the TPB was tested using a prospective measure of drivers' speeding behavior.

The final issue addressed in the present study concerned the effect of *prior* speeding behavior on behavioral intentions and subsequent behavior. Within the context of the TPB, it has been argued that prior behavior is important because it can be used to test the model's sufficiency (Ajzen, 1991). However, it is well known that, for a number of social behaviors, prior behavior has an effect on intentions and on behavior which is over and above the effect of TPB variables (e.g., for reviews see Conner & Armitage, 1998; Ouellette & Wood, 1998). This has led a number of researchers to argue for prior behavior as an additional predictor variable in social cognition models (e.g., Bentler & Speckart, 1979; Fredricks & Dossett, 1983). However, it may not be appropriate to consider prior behavior in this way because, as a direct predictor of future behavior, it offers little explanatory power (Ajzen, 1987). It could also be argued that the strong relationship between how frequently a behavior has been performed in the past and how frequently it is performed in the future merely demonstrates that the behavior is stable over time with the same factors determining behavior on both occasions (Ajzen, 1991, 2002; Eagly & Chaiken, 1993). In the present context, this would not enhance one's understanding of why drivers do (or do not) comply with legal speed limits.

Considering prior behavior as a moderator variable that changes the strength of the TPB-intention and TPB behavior relationships, on the other hand, is of more interest because understanding when the TPB variables are most predictive of intentions and behavior provides some insight into when changes in those variables are likely to affect intentions and behavior. Empirical evidence for a moderating effect of prior behavior exists, but there are conflicting results over the direction of the effect. Ajzen (2002), for example, presented a reanalysis of the data from a study into class attendance carried out by Ajzen and Madden (1986). The results showed that the relationships between the TPB variables and behavior *increased* in strength the more often the behavior was performed in the past. However, a study into health check attendance by Norman and Conner (1996) and a series of studies by Verplanken and colleagues into travel mode choices (Verplanken, Aarts, van Knippenberg, & Mooren, 1998; Verplanken, Aarts, van Knippenberg, & van Knippenberg, 1994) showed that the relationships between the TPB variables and intention and the relationships between the TPB variables and behavior *decreased* in strength the more often behavior was performed in the past. The explanation for the former moderating effect, according to Ajzen (2002), is that, "the frequency with which a behavior has been performed in the past is a good indication of the amount of direct experience with the behavior, and it is well established that the ability of attitudes and intentions to predict later behavior increases with amount of direct past experience (see Fazio & Zanna, 1981)" (p. 112). To explain the latter moderating effect it is necessary to turn to the concept of habit. A habit can be seen as a learned pattern of behavior that becomes automated through repetition (e.g., Mittal, 1988; Triandis, 1977, 1980). In considering how habit might account for TPB-behavior relationships decreasing in strength with increasing frequency of prior behavior, it is reasonable to infer that habit strength increases with the number of times a behavior has been performed in the past and, as a result, the influence of the TPB's conscious, or "planned", processes on how people behave are over-ridden, or at least weakened, by habit[1]. In the context of the present study, the latter

moderating effect seems more plausible given speeding while driving is regarded as the "sort of behavior that is built up in the course of experience and becomes part of someone's habitual driving style" (Manstead & Parker, 1996, p.6). Therefore, the hypothesis tested in the present study was that the relationships posited by the TPB would *decrease* in strength the more often drivers' reported complying with speed limits in the past.

To summarise, the main aims of the present study were as follows.

1. To test the predictive validity of the TPB with respect to not only behavioral intention but also a prospective measure of speeding behavior (self-reported compliance with speed limits while driving in built-up areas[2]).
2. To test the extent to which the TPB variables mediate the effects of demographic variables on drivers' compliance with speed limits.
3. To test the hypothesis that the relationships within the TPB and the relationships between TPB predictors and future speeding behavior decrease in strength with increasing frequency of prior behavior.

Method

Study Design

The study was prospective in design. At time 1, a random sample of 5,000 UK driving license holders drawn from the electoral roll were sent postal questionnaires designed to measure demographic variables, prior behavior, and TPB variables with respect to complying with speed limits while driving in built up areas over the next three months (see below for details). At time 2, three months later, respondents were sent a follow-up questionnaire in which they were asked to report their actual compliance with speed limits in built-up areas over the last three months (i.e., their behavior since completing the time 1 questionnaire). Before completing the questionnaires respondents were given the following instructions:

> "As part of its work into road safety, the Transport Research Laboratory (TRL Limited) in collaboration with the University of Sheffield is carrying out research into

drivers' attitudes towards keeping within the speed limit while driving in built-up areas. We would greatly appreciate your help by completing this questionnaire. To help you answer the questionnaire, it may help you to think of roads in built-up areas on which you have previously driven and base your answers on those. By roads in built-up areas we mean any roads with 20mph, 30mph or 40mph speed limits. Please answer all questions in relation to yourself. There are no right or wrong answers to any of the questions. We are interested in what you actually think."

Participants

At time 1 of the survey, a 19% response rate was achieved (N= 943). Although this response rate might be considered to be low it is comparable with response rates obtained from recent driver behavior surveys that have used similar length questionnaires to the one used in the present study (e.g., Broughton, & Baughan, 2002). It can also be accounted for in part by the fact that substantial proportions of license holders are not active drivers. Five hundred and ninety eight (63%) of the people responding at time 1 returned time 2 questionnaires. MANOVA indicated there were no significant differences between time 2 responders and non-responders with respect to the TPB variables and prior behavior. Therefore, time 2 non-responders were excluded from the analyses reported in this article.

Fifty seven percent of the sample was male (n = 341). The mean age was 51 years (range 18-85 years) and the mean reported weekly mileage was 194 miles (range 5-2000 miles). With respect to the measure of socio-economic group (SEG) used in the study, 36.6% of respondents reported being senior managerial, administrative or professional (SEG category A/B); 33.8% reported being junior managerial, administrative or professional, supervisory and clerical (SEG category C1); 12.3% were skilled manual workers (SEG category C2); 5.9% were semi-skilled or unskilled manual workers (SEG category D); and 11.4% were either students, housewife/husbands, or unemployed (SEG category E)[3].

Questionnaire Measures

The following measures were used in the present study:

Demographic measures. The following demographic variables were measured in the time 1 questionnaire: age, sex (coded as 1 = *male* and 2 = *female*), mileage, and socio-economic group (1 = *lowest SEG – category E* - through to 5 = *highest SEG – category A/B*).

Prior behavior. At time 1, two items were used to measure prior behavior. These were: 'How often have you kept within the speed limit while driving in built-up areas in the last 3 months?' (*Never-Nearly all the time*) and 'I have kept within the speed limit while driving in built-up areas in the last 3 months' (*Strongly disagree-Strongly agree*). Both items were measured on 7-point unipolar scales (+1 to +7). The mean of the two items was calculated to create a composite scale to be used in subsequent data analysis.

Attitude. Standard questionnaire items were used in this study to measure TPB components. To measure attitude towards the behavior, respondents used a semantic differential scale and were asked to complete the following statement by rating three pairs of adjectives, each on 7-point bipolar scales: 'If I kept within the speed limit while driving in built-up areas in the next 3 months it would be…' The three pairs of adjectives were: *'Harmful/Beneficial'*, *'Unpleasant/Pleasant'*, and *'Negative/Positive'*. Each item was scored from -3 to +3. The mean of the three items was calculated to produce a composite scale.

Subjective norm. A measure of subjective norm was obtained by calculating the mean of three items, each rated on 7-point unipolar scales (+1 to +7). The three items were: 'People who are important to me would want me to keep within the speed limit while driving in built-up areas in the next 3 months' (*Strongly disagree-Strongly agree*), 'People who are important to me would (*Disapprove-Approve*) of my keeping within the speed limit while driving in built-up areas in the next 3 months', and 'People who are important to me think that I (*Should not-Should*) keep within the speed limit while driving in built-up areas in the next 3 months'.

Perceived behavioral control. A measure of perceived behavioral control was obtained by calculating the mean of five items. Each item was rated by respondents on 7-

point unipolar scales (+1 to +7). The five items were: 'I believe that I have the ability to keep within the speed limit while driving in built-up areas in the next 3 months' (*I definitely do not-I definitely do*), 'Do you think that you will be able to keep within the speed limit while driving in built-up areas in the next 3 months?' (*Definitely no-Definitely yes*), 'If it were entirely up to me, I am confident that I would be able to keep within the speed limit while driving in built-up areas in the next 3 months' (*Strongly disagree-Strongly agree*), 'How confident are you that you will be able to keep within the speed limit while driving in built-up areas in the next 3 months?' (*Not at all confident-Very confident*), and 'If I kept within the speed limit while driving in built-up areas it would be' (*Difficult-Easy*).

Behavioral intention. The mean of three items was used as a measure of intention to keep within the speed limit while driving in built-up areas. Each item was rated on a 7-point bipolar scale (-3 to +3). The three items were: 'Do you intend to keep within the speed limit while driving in built-up areas in the next 3 months?' (*Definitely do not-Definitely do*), 'How much do you want to keep within the speed limit while driving in built-up areas in the next 3 months?' (*Not at all-Very much*), and 'How likely or unlikely is it that you will keep within the speed limit while driving in built-up areas in the next 3 months?' (*Unlikely-Likely*).

Future behavior. The same two items used at time 1 to measure prior behavior were used at time 2, three months later, to measure subsequent behavior. The mean of the two items was calculated to produce a composite scale for use in subsequent data analysis.

Results

Tests of Discriminant Validity

The items used to measure attitude, subjective norm and perceived control were subjected to principal components analysis with varimax rotation. The results provided strong evidence for the independence of the self-reported scales used to measure the independent variables within the TPB. Three factors with Eigenvalues greater than 1 emerged from the data with the rotated factors accounting for 72.2% of the variance. Items used to measure

perceived control loaded strongly onto factor 1 (.78 or better) and did not load onto the other two factors (a cut-off point for item loadings of .4 was used). Similarly, the items used to measure subjective norm loaded strongly, and only, onto factor 2 (.81 or better) and the items used to measure attitude loaded only onto factor 3 (.69 or better).

Descriptive Statistics and Correlations

In Table 1, Cronbach's α, means, standard deviations and zero order correlation coefficients for the scales used in the study are shown. The Cronbach's α statistics indicated the internal reliability for each scale was high (α = .82 or higher). The descriptive statistics indicated that respondents had positive intentions and attitudes, perceived social pressure from significant others, and perceived that they themselves had considerable control over whether they complied with speed limits while driving in built-up areas. At both time points, respondents reported often complying with speed limits[4]. Consistent with the TPB, attitude, subjective norm and perceived control were all positively correlated with behavioral intention, and intention and perceived control were positively correlated with future behavior.

Predictors of Intentions and Future Behavior

To address the first main aim of the study, hierarchical multiple regression analyses were conducted to identify the key predictors of behavioral intention (see Table 2) and future behavior (see Table 3). The key predictors of drivers' intentions to comply with speed limits while driving in built-up areas were identified by regressing behavioral intention on the demographic variables (step 1) and the TPB variables: attitude, subjective norm and perceived control (step 2). The results showed that the demographic variables accounted for a statistically significant proportion of the variance ($R^2 = .15$, $p < .001$). The TPB variables, when added to the regression equation, resulted in a substantial and statistically significant increment to R^2 ($R^2 = .63$, $R^2_{change} = .48$, $p < .001$). In support of the TPB, the standardized regression coefficients (see step 2 beta weights in Table 2) indicated that attitude, subjective norm and perceived control were all statistically significant independent predictors of

intention (β = .11, $p < .001$; β = .25, $p < .001$; and β = .53, $p < .001$, respectively). Age (β = .13, $p < .01$) and sex (β = .09, $p < .01$) were also statistically significant predictors.

The key predictors of drivers' reported compliance with speed limits were identified by regressing future behavior on the demographic variables (step 1), and on all TPB variables (step 2). The results of this analysis showed that the demographic variables accounted for a statistically significant proportion of the variance in future behavior ($R^2 = .17$, $p < .001$). The addition of the TPB variables to the regression model resulted in a substantial and statistically significant increment to R^2 ($R^2 = .49$, $R^2_{change} = .32$, $p < .001$). In line with the TPB, the standardized regression coefficients (see step 2 beta weight in Table 3) indicated that intention and perceived control were statistically significant independent predictors of future behavior (β = .46, $p < .001$ and β = .23, $p < .001$, respectively). Age was also a significant independent predictor (β = .21, $p < .001$) and SEG had a small but statistically significant independent effect (β = -.07, $p < .05$).

Mediation

To address the second aim of the study, the standard procedure to test for mediator effects (see Baron & Kenny, 1986) was adopted. First, the dependent variable (i.e., future behavior) was regressed on the independent variables (i.e., demographics) to test for significant effects. The proposed mediators (i.e., TPB variables) were then regressed on the independent variables to test for significant effects. Finally, the dependent variable was regressed on the independent variables and the proposed mediators to test whether TPB variables had significant effects on future behavior and whether the demographics had weaker effects on future behavior when controlling for the TPB variables.

When future behavior was regressed on the demographic variables (see beta weights by step 1 in Table 3), the first condition necessary to establish a mediation effect was satisfied with respect to age (β = .40, $p < .001$), sex (β = .13, $p < .01$) and SEG (β = -.14, $p < .01$). Mileage did not have a statistically significant independent effect on future behavior (β

= -.07, p= .07) and was therefore not included in further steps of this analysis. Older drivers, female drivers and drivers from lower SEGs reported complying with speed limits in built-up areas more often than did younger drivers, male drivers and drivers from higher SEGs.

The second condition to establish mediation was satisfied when the demographic variables were regressed on the TPB variables. With the exception of the SEG-attitude and SEG-perceived control relationships, the demographic variables had statistically significant effects on the TPB variables. Age and sex were both statistically significantly associated with attitude (β = .16, p < .001 and β = .21, p < .001, respectively), subjective norm (β = .24, p < .001 and β = .09, p < .05, respectively), perceived control (β = .25, p < .001 and β = .17, p < .001, respectively) and intention (β = .34, p < .001 and β = .23, p < .001, respectively). SEG had statistically significant effects on subjective norm (β = -.15, p < .001) and intention (β = -.11, p < .01). Older drivers and female drivers had more positive intentions and attitudes, perceived more pressure from significant others, and had greater perceived control than did younger drivers and male drivers. Drivers from lower SEGs perceived more pressure from significant others and had more positive intentions to comply with speed limits than did drivers from higher SEGs.

The third condition necessary to establish a mediation effect was satisfied when future behavior was regressed on the TPB and the demographic variables (see step 2 beta weights in Table 3). Intention and perceived control had statistically significant independent effects on future behavior (β = .46, p < .001 and β = .23, p < .001, respectively). The effects of age (β = .21, p< .001) and SEG (β = -.07, p< .05) were weaker than they were in the first regression model, although they both remained statistically significant predictors of behavior. Sex was no longer a statistically significant predictor (β = .02, p = .55). These results suggested that the TPB had a mediating influence on the demographic-behavior relationships.

To test whether there was a statistically significant decrease in the predictive validity of the demographic variables when controlling for TPB variables, the difference between the

unstandardized beta weights for each demographic variable in the first and third regression analyses were compared following Edwards (1984). Age, $t(1192) = 2.62$, $p <. 01$, and sex, $t(1192) = 2.22$, $p < .05$, were significantly weaker predictors of future behavior in the third regression analysis (i.e., when controlling for the TPB variables) than they were in the first regression analysis. However, the relationship between SEG and future behavior was not significantly weaker when controlling for the TPB variables, $t(1192) = 1.20$. These results suggested that the TPB was a powerful mediator of the age-behavior and sex-behavior relationships; although the TPB's mediating effect on the SEG-behavior relationship was not statistically significant.

Prior Behavior as a Moderator

To test the hypothesis that prior behavior moderates the relationships postulated by the TPB, the standard procedure for establishing moderator effects was conducted (see Baron & Kenny, 1986). This involved calculating the two-way interaction terms between the TPB variables and prior behavior (e.g., attitude x prior behavior) and including these in hierarchical multiple regression analyses in addition to the TPB variables and prior behavior. The variables used in these analyses were mean-centered before the interaction terms were computed to reduce possible effects of multicollinearity (see Dunlap & Kemery, 1987).

Table 2 shows the results of the moderator analysis for behavioral intention. The prediction of intention by attitude, subjective norm, and perceived control ($R^2 = .63$, $p < .001$) was significantly improved by including prior behavior ($R^2 = .74$, $R^2_{change} = .11$, $p < .001$) and by including the interaction terms ($R^2 = .76$, $R^2_{change} = .02$, $p < .001$). Examination of the standardized regression coefficients (see step 4 beta weights in Table 2) showed that the perceived control x prior behavior interaction was the only statistically significant interaction term ($\beta = -.12$, $p< .001$). Thus the results suggested that prior behavior moderated the relationship between perceived control and intention but not the relationships between attitude and intention, and subjective norm and intention.

Simple slope analysis (see Aiken & West, 1991) was conducted to probe the nature of the perceived control x prior behavior interaction. Perceived control was a statistically significant predictor of intention at low (mean - 1 SD), moderate (mean) and high (mean + 1 SD) levels of prior behavior. However, the size of the standardized regression coefficients showed that as prior behavior increased in frequency, the relationship between perceived control and intention decreased in strength ($\beta = .58$, $p < .001$; $\beta = .39$, $p < .001$; and $\beta = .19$, $p < .001$ at low, moderate and high levels of prior behavior, respectively).

The results of the moderator analysis for future behavior are presented in Table 3. The prediction of future behavior by the TPB variables ($R^2 = .49$, $p < .001$) was significantly improved by adding prior behavior to the regression model ($R^2 = .53$, $R^2_{change} = .04$, $p < .001$) and by adding the interaction terms ($R^2 = .54$, $R^2_{change} = .01$, $p < .05$). Inspection of the standardized beta weights (see step 4 beta weights in Table 3) showed that the perceived control x prior behavior interaction was statistically significant ($\beta = -.15$, $p < .01$), suggesting that prior behavior moderated the relationship between perceived control and future behavior.

Simple slope analysis showed that the relationship between perceived control and future behavior decreased in strength with increasing frequency of prior behavior. At low (mean - 1 *SD*) and moderate (mean) levels of prior behavior, perceived control predicted future behavior significantly ($\beta = .39$, $p < .001$ and $\beta = .24$, $p < .001$, respectively). However, at high levels of prior behavior (mean + 1 *SD*) perceived control did not significantly predict future behavior ($\beta = .10$, $p = .12$). Thus, the results suggested that the more frequently drivers' complied with speed limits in built-up areas in the past, the less predictive their perceptions of control were of their future compliance behavior.

Discussion

Support for the TPB

The present study provided strong support for the application of the TPB to drivers' compliance with speed limits. Attitude, subjective norm and perceived control accounted for

substantial increments to explained variance in drivers' intentions to comply with speed limits while driving in built-up areas over and above the demographic variables. As with previous research applying the TPB to exceeding the speed limit (e.g., Forward, 1997; Manstead & Parker, 1996; Parker et al., 1992), attitude, subjective norm and perceived control were significantly positively associated with behavioral intention. More importantly, the results demonstrated that the TPB was able to provide a good account of speeding behavior as measured prospectively over a 3 month time period. Intention to comply with the speed limit and perceived control together accounted for a substantial proportion of the variance in subsequent compliance behavior over and above that accounted for by the demographic variables. In line with the TPB, both intention and perceived control were significantly positively associated with behavior. These results were highly encouraging given that a prospective assessment, rather than a cross sectional or a retrospective assessment, of the predictive validity of the TPB was carried out.

In both the prediction of behavioral intention and future behavior, the size of the standardized beta weights in the regression analyses indicated that the TPB variables were generally far more important predictors than were the demographic variables. Evidence was also obtained showing that the TPB was a significant mediator of the age-behavior and sex-behavior relationships. Although the TPB mediated the effects of SEG on behavior, its mediating impact was not statistically significant. These results suggest that other social cognitive variables may be required to explain the SEG-behavior relationship. Personal identity and moral norm are examples of social cognitive variables outside the scope of the TPB that have been used in previous research studies to predict speeding behavior (e.g., Manstead & Parker, 1996). Further research investigating the ability of these variables to mediate demographic-behavior relationships may be required. Although in the present study, the TPB was unable to fully mediate the effects of SEG on behavior, in general, the variables within the TPB were good mediators of the demographic-behavior relations and thus they

could help explain the relationships between the demographic characteristics of drivers and their speeding behavior. These variables might prove to be useful targets for road safety interventions (discussed below).

Prior Behavior as a Moderator Variable

The present study provided some support for prior behavior as a moderator variable within the context of the TPB. Prior behavior was found to moderate the perceived control-intention and the perceived control-behavior relationships. In support of Norman and Conner (1996) and Verplanken and colleagues (Verplanken et al., 1994, 1998), the strength of these relationships decreased with increasing frequency of prior behavior. These findings are consistent with the argument that when a behavior has been performed often in the past, future behavior is based less on conscious processes as outlined by the TPB (e.g., perceived control) but on more automatic processes (e.g., by habit). This does not necessarily call into question the importance of attitudes in governing behavior. It is a possibility that when performed often in the past speeding behavior is based on attitudes and intentions that are automatically selected in the presence of appropriate environmental cues. This position coincides with previous research demonstrating that, given the appropriate environmental cues, higher order mental processes such as attitudes can be activated to guide behavior without conscious deliberation (e.g., Bargh, Chaiken, Govender, & Pratto, 1992; Bargh & Ferguson, 2000; Fazio, Sanbonmatsu, Powell, & Kardes, 1986). This issue, however, cannot be assessed in survey research such as that reported here because when respondents are asked to think about and respond to attitude items in a questionnaire, their attitudes will naturally reach a certain level of consciousness. Other (experimental) techniques, such as those reported by Fazio et al. (1986) are required to investigate this issue, and the application of such techniques is a potential avenue for further research into drivers' speeding behavior.

Implications for Road Safety Interventions

The inherent usefulness of social cognition models such as the TPB is that they can be

used to identify variables to target in interventions. Given strong support for the TPB's application to drivers' compliance with speed limits was provided by the present study, it seems feasible that desirable changes in drivers' attitudes, subjective norms and perceptions of control might lead to corresponding changes in their intentions and behavior. Specifically, the results of the present study suggest that road safety interventions may be most successful if they focus on the perceived control component of the model given this component was the most important predictor of behavioral intention as indicated by the size of the standardized beta weights in the regression analysis. A large body of work has shown that promoting perceived control increases the likelihood that an individual will successfully perform a number of social behaviors. To date, effective strategies for increasing perceived control have included: sub-tasking, modelling, and guided performance of behavior (for a review see Bandura, 1997). These strategies might be useful for promoting road safety behavior.

The finding that drivers based their intentions to comply with speed limits, and their compliance behavior, more on their perceptions of control the less often they complied with speed limits in the past also has practical implications for road safety interventions. On the basis of these results it is reasonable to suggest that interventions focusing on the perceived control component of the model are more likely to have success in changing the behavior of drivers who do not often comply with speed limits. This is encouraging from a practical road safety point of view because drivers who often comply with the speed limit while driving in built-up areas already carry out the desirable course of action and, therefore, their behavior does not require modifying. Drivers who do not often comply with speed limits, however, do need their behavior changing from a road safety point of view.

Although the notion of changing behavior via changes in attitudes is attractive, previous research has not demonstrated convincingly that changing drivers' attitudes produces systematic changes in behavior and/or behavioral intentions. There may be a number of reasons for this. For instance, some studies are laboratory based (e.g., Parker,

Stradling, & Manstead, 1996) and artificial laboratory situations may not be conducive to bringing about changes in attitudes, intentions and behavior. Other, non-laboratory, studies have used small sample sizes (e.g., Meadows & Stradling, 1999), making it difficult to achieve statistically significant results. Research conducted in non-laboratory situations and using large sample sizes to evaluate attitude change interventions based on the TPB may be required to fully investigate the potential for influencing driver attitudes, intentions and behavior. Incorporating these attitude change interventions into driver skills training courses may be effective and is worth research attention.

Limitations of the Present Study

A possible limitation of the present study is that a self-reported measure of speeding behavior was used. Although self-reported behavior measures can be criticised for being subjective, the findings of the present study are held with confidence. Research has shown that significant and reasonably strong correlations can be found between self-reported and more objectively measured driver speed (e.g., Aberg, Larsen, Glad & Beilinsson, 1997; De Waard & Rooijers, 1994). Self-report is also widely recognised as a valuable methodology in social research (e.g., Corbett, 2001) and, in the context of the present study, obtaining a more objective measure of prospective behavior (e.g., on road driving performance) would be very costly, probably resulting in small sample sizes being achieved. However, it would still be desirable to apply the TPB to a more objective measure of future speeding behavior than self-report. Driving simulators are potentially useful research tools for investigating this issue.

Conclusions

In conclusion, the present study provided strong support for the application of the TPB to drivers' compliance with speed limits while driving in built-up areas. Some support was provided for the consideration of prior behavior as a moderator variable within the context of the TPB. Further empirical research is required to explore how TPB variables can be manipulated to bring about desirable changes in drivers' speeding intentions and behavior.

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Footnotes

[1] Further support for this argument comes from studies which have assessed habit by asking respondents to rate their habit strength (e.g. Trafimow, 2000). However, asking respondents to consciously rate psychological processes that are automatic leads to questions regarding the validity of the measures. Therefore, in line with Verplanken et al. (1994 & 1998) self-reported frequency of prior behavior was used in this study rather than a more direct self-reported measure of habit strength. Although it is recognised that there are a number of problems inferring habit directly from frequency of past behavior (see Ajzen, 2002), a moderating effect of prior behavior such as that found by Verplanken et al. (1994, 1998) is consistent with the argument that habit may override the effect of the TPB variables on behavior.

[2] The decision to study drivers' compliance with speed limits specifically in built-up areas as opposed to a more generic class of speeding behavior was based on two rationales. First, previous research in road safety has shown that drivers perceive speeding differently on different road types (e.g., Quimby, 1998; Stradling & Parker, 1997). Second, statistics show that most accidents in Great Britain occur on roads in built-up areas (DETR, 2000). For the purposes of this study, roads in built-up areas were defined in the same way as defined by the National Accident Database System in Great Britain (STATS19), that is any road with a 20, 30, or 40 mph speed limit.

[3] The measure of SEG used in this study was based on the Market Research Society's (MRS) classification in Great Britain (see Reynolds, 1991). This classification ranges from A (i.e. people who live at the highest levels of subsistence) through to E (i.e. people who live at the lowest levels of subsistence). It is recognised that classifying people according to these

categories can be complex, being based on a number of different variables. However, limited questionnaire space in the present study meant that a short 1-item measure of SEG needed to be used. With this in mind, an item was used which required respondents to classify themselves according to the five broad definitions of occupation group described here.

[4] The descriptive statistics indicated the variables used in the study were negatively skewed. Subsequent examination of the distributions confirmed this and, following Tabachnick and Fidell (1996), all variables were transformed as necessary to reduce skewness. All results presented in this article are based on analyses conducted using the transformed variables.

Table 1.

Descriptive Statistics and Zero Order Correlations for TPB Variables, Prior Behavior and Future Behavior

Variable	No. of items in scale	Cronbach's α	*M*	*SD*	Range	1.	2.	3.	4.	5.	6.
1. Future behavior	2	.83	5.98	1.16	+1 to +7	-	.67	.34	.37	.64	.69
2. Behavioral Intention	3	.91	2.16	1.18	-3 to +3		-	.51	.57	.79	.81
3. Attitude	3	.82	2.54	0.84	-3 to +3			-	.42	.48	.42
4. Subjective Norm	3	.82	6.12	1.19	+1 to +7				-	.49	.45
5. Perceived Behavioral Control	5	.92	5.75	1.38	+1 to +7					-	.78
6. Past behavior	2	.84	5.77	1.36	+1 to +7						-

Note. For all correlation coefficients $p < .001$

Table 2.

Predictors of Intentions

Step	Predictor	R^2	R^2 change	F change	Step 1 β	Step 2 β	Step 3 β	Step 4 β
1.	Age	.15	.15	25.35***	.33***	.13***	.04	.04
	Sex				.20***	.09**	.07**	.07**
	SEG				-.11**	-.04	-.01	.00
	Mileage				-.10**	-.01	.00	.01
2.	Attitude	.63	.48	250.67***		.11***	.09***	.06*
	Subjective Norm					.25***	.18***	.18***
	Perceived Control					.53***	.21***	.23***
3.	Prior Behavior	.74	.11	263.00***			.52***	.54***
4.	ATT x PB	.76	.02	14.91***				-.02
	SN x PB							-.02
	PBC x PB							-.12***

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

Note. ATT x PB = attitude x prior behavior interaction term; SN x PB = subjective norm x prior behavior interaction term; PBC x PB = perceived behavioral control x prior behavior interaction term.

Table 3.

Predictors of Future Behavior

Step	Predictor	R^2	R^2 change	F change	Step 1 β	Step 2 β	Step 3 β	Step 4 β
1.	Age	.17	.17	30.12***	.40***	.21***	.18***	.18***
	Sex				.13**	.02	.03	.03
	SEG				-.14**	-.07*	-.06*	-.07*
	Mileage				-.07	.01	.01	.01
2.	Attitude	.49	.32	93.53***		-.02	-.01	.01
	Subjective Norm					-.05	-.04	-.03
	Perceived Control					.23***	.13**	.15**
	Intention					.46***	.25***	.23***
3.	Prior Behavior	.53	.04	45.56***			.35***	.35***
4.	ATT x PB	.54	.01	3.26*				.06
	SN x PB							-.02
	PBC x PB							-.15**
	INT x PB							.07

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

Note. ATT x PB = attitude x prior behavior interaction term; SN x PB = subjective norm x prior behavior interaction term; PBC x PB = perceived behavioral control x prior behavior interaction term; INT x PB = behavioral intention x prior behavior interaction term.

Figure 1. Theory of Planned Behavior (Ajzen, 1985)