Road user behaviour with special focus on vulnerable road users

Lars Åberg

Dalarna University and Uppsala University, Sweden

Abstract

Violation of traffic rules is an important factor behind traffic accidents. Attempts to explain why drivers are violating have shown that attitudes, norms and driver interactions are important factors. A questionnaire, based on the theory of planned behaviour (TPB), has been used to explore effects of attitudes, norms, perceived behaviour control, etc. on various self reported violations in traffic. The questionnaire was administered to a sample of license holders and more than 1800 answers were obtained (return rate 68%). Factor analyses of thirteen different self reported violations resulted in three distinct dimensions of violation – speeding, close following and violations against unprotected road users. In the this paper a comparison between TPB-models explaining speed violations and violations against unprotected or vulnerable road users, respectively, will be presented.

Introduction

It has been estimated that more than a 1.2 million persons are killed in road traffic each year all over the world and this figure is increasing (Peden et al, 2004). Violation of traffic rules is an important factor behind traffic accidents and many lives could be saved if all drivers complied with the rules. The Swedish National Road Administration has stressed the importance of speeding, drunk driving and non-use of safety belts as the main causes of accidents on Swedish roads (Swedish road administration, 2006). Speeding is a major factor behind road accidents (Nilsson, 1982) on both rural and urban roads. Accident rates, for example, are directly proportional to change in mean speed and rates of injuries and fatalities increase even faster. As decreases in mean speed affects the rate of accidents, a reduction of the number of speeding vehicles will increase safety in traffic. It is well known that traffic rules like speed limits has been found to decrease the number of speeding drivers (Elvik & Vaa, 2004; Evans, 1991) and the same is true for police surveillance (see Åberg, 1998). However different traffic rules differ with respect to their acceptance in the population, something that might be related to the influence of social factors, like social norms and attitudes (see Åberg, 1998). Attempts to explain why drivers are violating have also shown that attitudes, norms and driver interactions are important factors behind these behaviours. A theoretical framework based on the theory of planned behaviour (TPB), has been used to explore effects of attitudes, norms, perceived behaviour control, etc. on various self reported violations in traffic (e.g. Parker & Manstead 1996, Åberg, 1998, Wallén Warner, 2006). In addition to the traditional TPB variables influences from other road users are important for compliance with traffic rules and for safe behaviour in traffic. Normally social influences might come from different sources of information. In traffic, with more or less direct interaction between road users, drivers will learn about others' compliance with the rules through perceptions of others' behaviour (Björklund, 2005).

According to the Theory of Planned Behavior (TPB) suggested by Ajzen (1991) human actions (or behaviours) are determined by intentions to act in a certain way. The intentions, in turn, are determined by attitudes towards the behaviour, the subjective norms of the actors and their perceived behaviour control. As drivers normally interact with each other

(See Åberg, Afram, & Nilsson, 2005) an extended version of the TPB including perceived behaviour of other drivers will be used in the present. As others behaviour to some extent is an external variable like PBC it is likely that it might influence both intentions and actual behaviour. The extended version of the TPB is presented in figure 1.

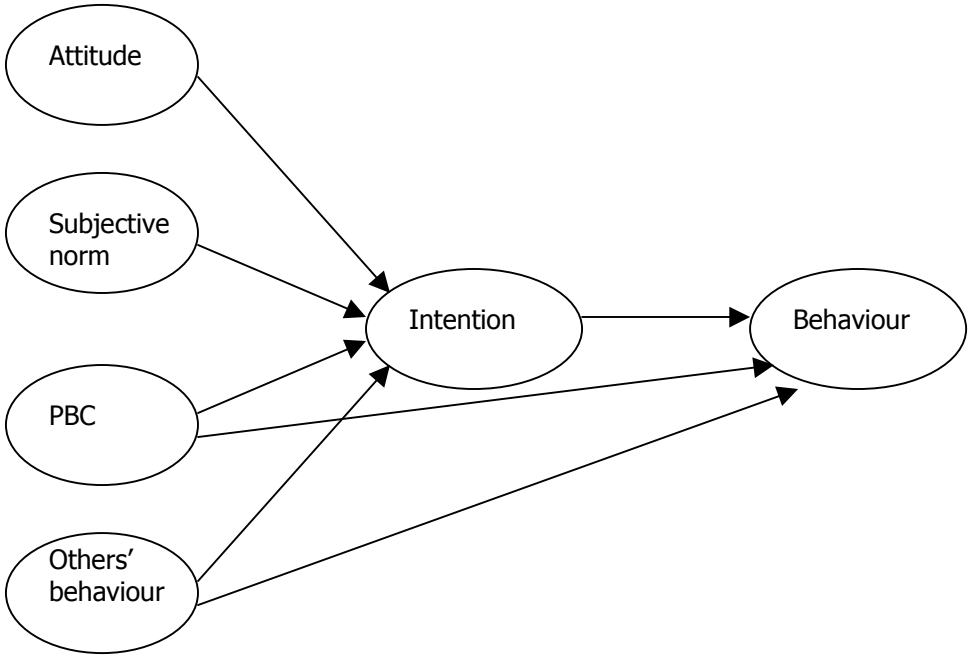

Figure 1. The theory of planned behaviour (after Ajzen, 1991) extended with other drivers' behaviour.

In a number of studies of speeding in Sweden, drivers have been interviewed about their own and others speed and the answers have been related to observed speeding and self reported speeding. Speeds of passing vehicles were measured along roads in urban- or rural areas and drivers were stopped by police and interviewed by researchers. In Sweden 532 drivers were stopped and asked questions about their speed choice. The mean observed speed on 50km/h and 90 km/h roads was slightly over the speed limit and 16% to 23% of the drivers drove faster than 10km/h over limit. The mean self-reported speed was about the same as the mean observed speed while the drivers believed that more than 50% of the vehicles went faster than 10 km/h over limit. (Åberg, et al 1997; Haglund and Åberg, 2000). The TPB has been found to be a good predictor of both long term observed speeding and self-reported speeding in a 2-4 year study of effects of an intelligent speed adaptation system (Wallén Warner, 2006). Although there are several studies of speed behaviour where the TPB has been useful as a frame of reference no studies have been found where TPB have been used in studies of drivers' interaction with unprotected road users.

Problem

In the present paper a comparison will be made between the TPB's ability to explain speeding and violation against vulnerable road users, respectively. The problem of the present paper is to investigate if the TPB can be used to study self reported violations directed against vulnerable road users' safety and if the structure of relationships among the model variables differ from the relationships observed for speeding.

Method

A questionnaire was administered to a sample of 2800 license holders between 18 and 74 years old from the whole country of Sweden. Answers were obtained from 1895 subjects (68%) and 1720 questionnaires (62%) could be used for the present study, 55% males and 45% females. The questionnaire is based on the TPB. Violations were measured on a 6-point scale (from 1=never to 6=always). Intention, attitude, subjective norm, perceived behaviour control were measured on 5-point scales and others' behaviour was measured on a percentage scale (1%-100%).

Thirteen different self reported violations were investigated (speeding 15 km/h over limit on 30 to 110 km/h roads, forcing others to drive on the road shoulder, close follow in urban and rural traffic, ignoring stop-signs or red lights, not stopping for pedestrians or bicyclists and overtaking on a pedestrian crossing). A principal component analysis (PCA) was performed on self reported behaviour concerning 13 different violations (Speeding on roads (five different speed limits), close following, driving on the road shoulder, not stopping at stop sign or red light, not giving way to pedestrians or cyclist). The result after exclusion of three violation items (about close following and driving on the road shoulder) was a two-factor solution explaining 60% of the variance. One factor included speeding items (explaining 33% of the variance and with the highest loading for speeding on 90km/h roads) and the other violations against unprotected road users (explaining 27% and where "not giving way to pedestrians" got the highest loading). For each of the TPB factors, and for violations against speed limits or unprotected road users, indices were computed (behaviour (B), intention (I), attitude (A), subjective norm (SN), perceived behaviour control (PBC), and others behaviour (OB)).

Results

The number of subjects who admitted to violate against the rules at least "rather seldom" (3 or more on the 6-point scale) are presented in figure 2 where it is shown that speeding violations were reported much more frequently (27% - 69%) than violations against vulnerable road users (1% - 20%). Indices for the different violations are presented in figure 3. Both distributions are uni-modal although the variance of violations against unprotected road users is more restricted. In table 1 the correlations between TPB indices are presented together with alpha coefficients. It can be observed that the results in table 1 shows that the inter-correlation between TPB variables vary from .21 to .56 (median.39) for the unprotected while for speeding they vary from .15 to .75 (median .49). Cronbach's α varies from .62 to .89 (median .85).

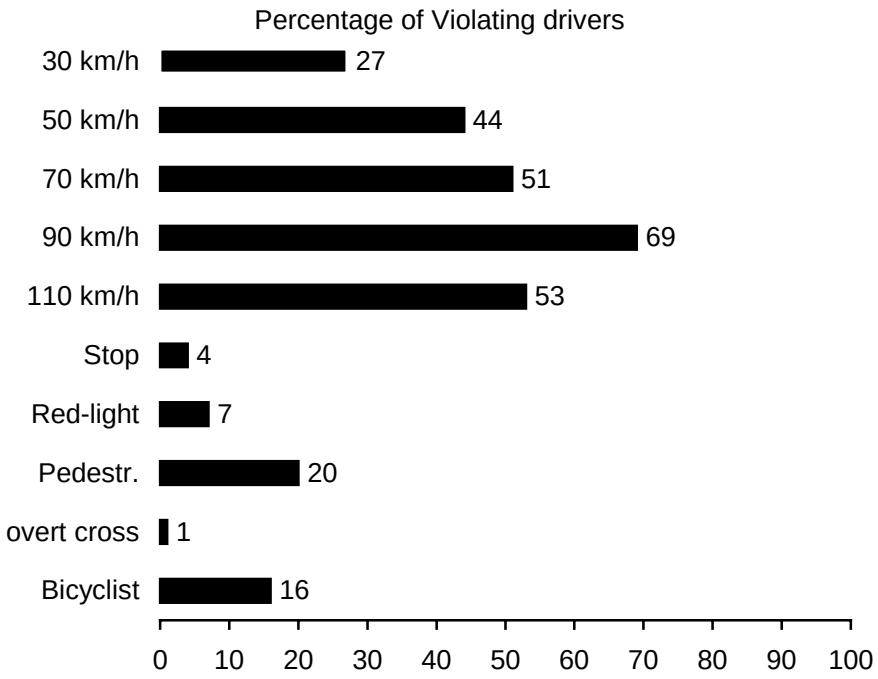

Figure 2. Percentages of drivers that have been violating "rather seldom" (3) to "always" (6). For speeding and for violations against unprotected road users.

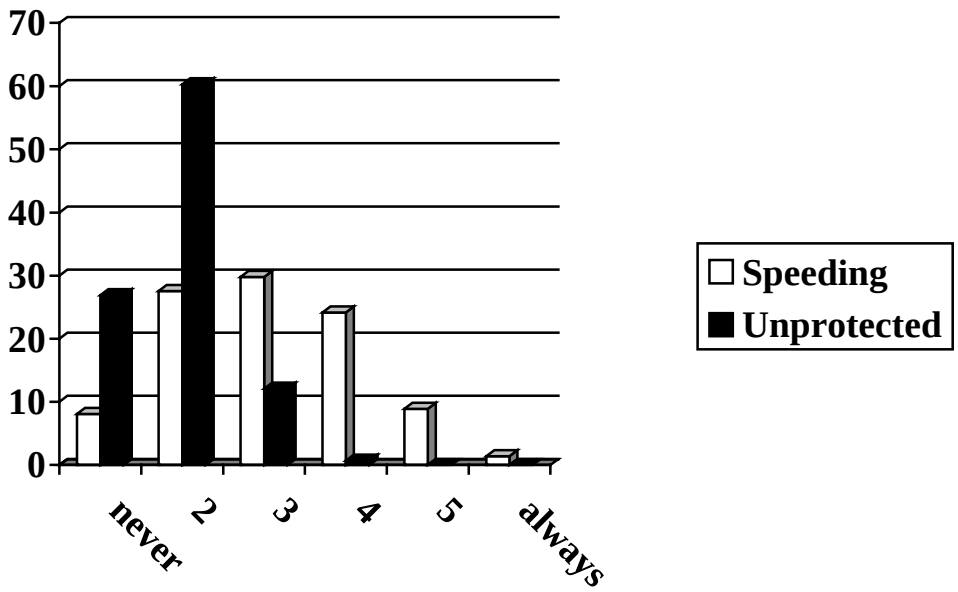

Figure 3. Distributions of indices for violations against speed limits and against vulnerable road users

Table 1. Correlations between TPB-variables: Behaviour (B); Intentions (I); Attitudes (A); Subjective norm (SN); Perceived behaviour control (PBC); and Others' behaviour (OB). Data from speeding violations above the diagonal and data from violation against unprotected road users below the diagonal. Cronbach's α are presented in the last column and the last row.

	B	I	A	SN	PBC	OB	α
B	-	.747	.619	.488	.601	.306	.851
I	.557	-	.646	.503	.561	.250	.865
A	.409	.503	-	.581	.451	.181	.859
SN	.391	.499	.518	-	.338	.214	.892
PBC	.436	.461	.352	.370	-	.146	.747
OB	.314	.282	.257	.286	.213	-	.882
α	.619	.772	.854	.872	.760	.817	

All coefficients are significant p<.01

To test the TPB model two consecutive analyses of regression were performed. In the first step intentions were regressed on attitudes, subjective norm, perceived behaviour control, and others behaviour. In the second step violations were regressed on intentions, perceived behaviour control and others behaviour. The results are presented in figure 4, for speeding, and figure 5, for violations against unprotected road users.

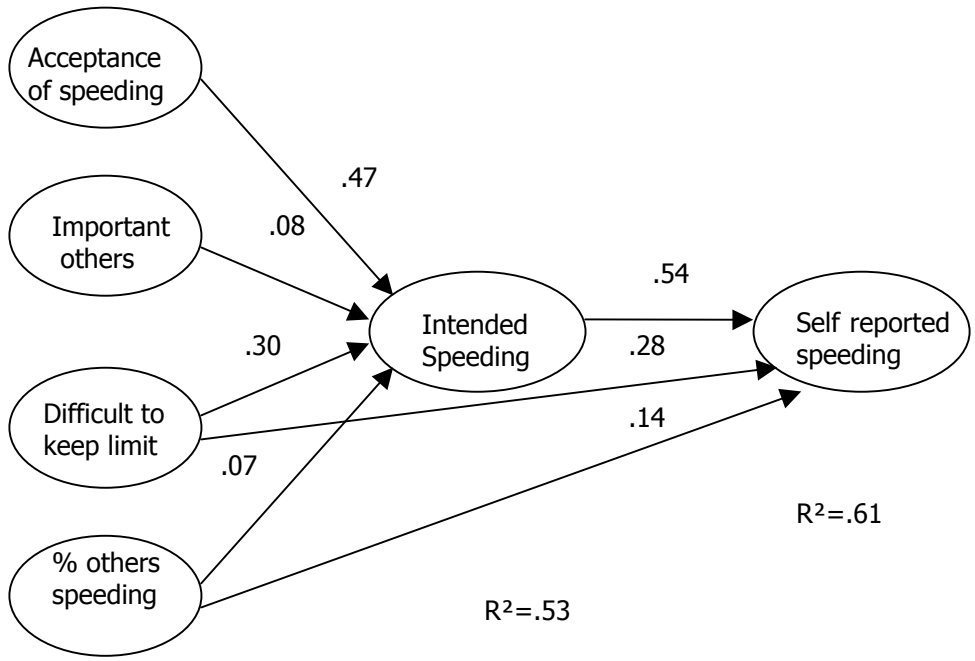

Figure 4. The TPB model applied on speeding violations.

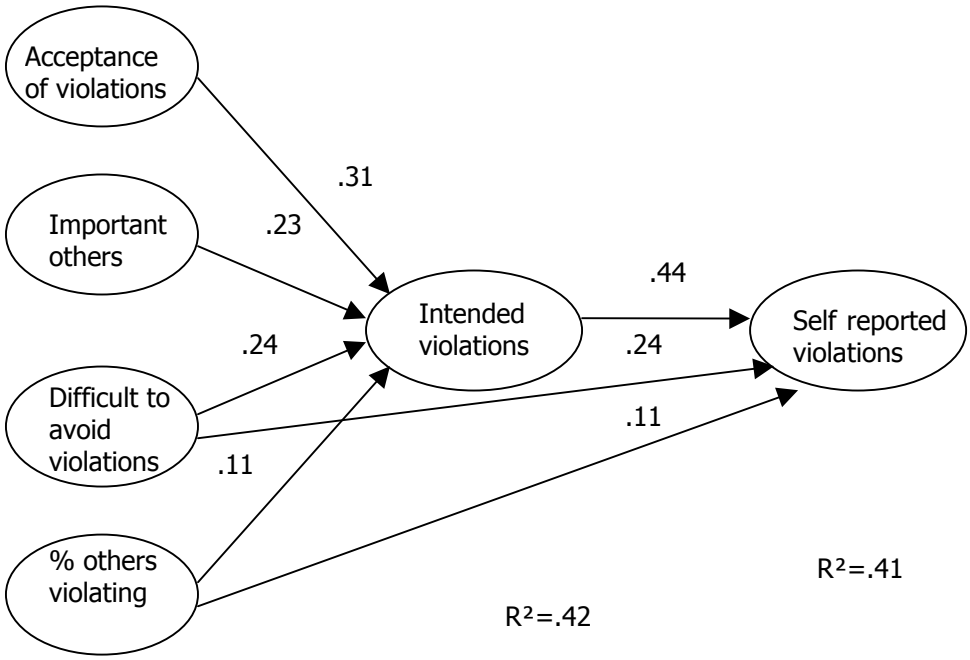

Figure 5. The TPB model applied on violations against unprotected road-users.

The models presented in figures 4 and 5 show that the TPB can explain 61% and 41% of the variation in self reported traffic violations against speed limits and against carefulness towards unprotected road users, respectively. Concerning intentions to violate the TPB can explain 53% and 42% of the variance. Although all paths of the models are significant ($p>.001$) the two models differ also from each other with respect to importance of different variables. For intentions to speed, attitudes and difficulty to keep the limit are important factors while subjective norm and others behaviour are less important. For future violations against unprotected road users the roll of important others and other drivers behaviour are more important. In both models there are strong contributions from perceived behaviour control and from others' behaviour.

Concerning salient behaviour beliefs and evaluations four beliefs (obtained through a pilot study) were investigated: the necessity to follow traffic rhythm; the importance of fast traveling; the risk of accidents; and the risk of being fined. The mean products (belef x evaluation) are presented in figure 6.

The results in figure 6. show that it is more important for the subjects to avoid accidents or punishment than to follow the pace of traffic or to reach the destination faster. Risks of accidents and punishment are more important in urban traffic with many unprotected road users than in rural traffic where high speeds are possible. All differences between speeding and violations against unprotected road users are significant ($p<.001$). All salient beliefs were significantly related to respective attitudes except accidents for unprotected road users (As almost all drivers stressed high risk of accident the variation in this variable became too restricted something that might have attenuated the correlation).

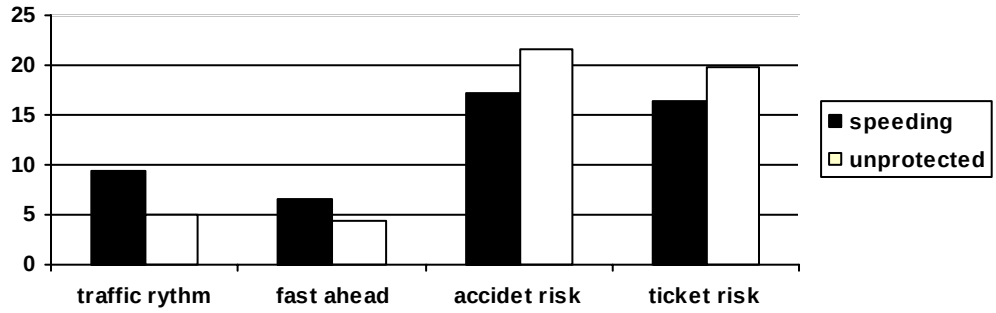

Figure 6. Mean products of behaviour beliefs and evaluations for speeding and for violations against unprotected road-users (scale: 1 – 25).

Discussion

Previously, TPB have successfully been used to explain violations against speed limits (e.g. Wallén Warner, 2006) and the present result is no exception. Violations against unprotected or vulnerable road users have not been investigated to the same extent as speed violations. One complication, in such studies, is that in comparison to speeding violations very few of the drivers admit having violated against vulnerable road users. This in turn leads to restricted variation in TPB-variables and consequently problems to test the model. However, by aggregating five different behaviours it was possible to apply the TPB-model on data and explained self reported behaviour was explained (although not to the same extent as the model explained speeding – probably due to the problem with restricted variance).

In previous studies we have noticed that some drivers argue that they want to behave like others in traffic. Therefore the TPB-model was extended to include "other drivers' behaviour" and this new variable added significantly to the explanations both for violations against speed limits and against vulnerable road-users. The main difference between the two models presented in the present paper is that attitudes (acceptance of violations) is more important for the `speeding´ model while the subjective norm is more important in the `vulnerable´ model. Also, when the beliefs underpinning attitudes are considered the accident risk and the risk of being fined are more important for violations against vulnerable road users while following the rhythm of traffic and to reach the destination fast are more important for speeding.

The results from the present study concern the situation in Sweden a few years ago but they point to a useful method to compare different traffic behaviours in different cultures. I can also be used to investigate possible reasons for differences in traffic safety between different countries.

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