Article:
Rowe, R., Andrews, E., Harris, P. et al. (3 more authors) (2016) Identifying beliefs underlying pre-drivers' intentions to take risks: An application of the Theory of Planned Behaviour. Accident Analysis and Prevention, 89. pp. 49-56. ISSN 0001-4575

https://doi.org/10.1016/j.aap.2015.12.024

---

22 December 2015

Identifying beliefs underlying pre-drivers' intentions to take risks: An application of the Theory of Planned Behaviour

Richard Rowe[1], Elizabeth Andrews[2], Peter R. Harris[3], Christopher J Armitage[4], Frank P. McKenna[5] and Paul Norman[1]

[1]Department of Psychology, University of Sheffield, UK

[2]Bradford Institute for Health Research, UK

[3]School of Psychology, University of Sussex, UK

[4]Manchester Centre for Health Psychology, School of Psychological Sciences, Manchester Academic Health Science Centre, University of Manchester, UK

[5]University of Reading, UK

Address correspondence to: Dr Richard Rowe, Department of Psychology, University of Sheffield, Western Bank, Sheffield, S10 2TN. **Tel:** (+44) (0)114 22 26606. **Fax:** (+44) (0)114 22 26515. **Email:** r.rowe@sheffield.ac.uk

Abstract

Novice motorists are at high crash risk during the first few months of driving. Risky behaviours such as speeding and driving while distracted are well-documented contributors to crash risk during this period. To reduce this public health burden, effective road safety interventions need to target the pre-driving period. We use the Theory of Planned Behaviour (TPB) to identify the pre-driver beliefs underlying intentions to drive over the speed limit (N=77), and while over the legal alcohol limit (N=72), talking on a hand-held mobile phone (N=77) and feeling very tired (N=68). The TPB explained between 41% and 69% of the variance in intentions to perform these behaviours. Attitudes were strong predictors of intentions for all behaviours. Subjective norms and perceived behavioural control were significant, though weaker, independent predictors of speeding and mobile phone use. Behavioural beliefs underlying these attitudes could be separated into those reflecting perceived disadvantages (e.g., speeding increases my risk of crash) and advantages (e.g., speeding gives me a thrill). Interventions that can make these beliefs safer in pre-drivers may reduce crash risk once independent driving has begun.

Introduction

Road traffic crashes are a serious challenge to public health. On UK roads there were 1754 fatalities and 23039 serious injuries during 2012 (Department for Transport, 2013). Novice drivers are over-represented in crash statistics, with particular vulnerability during the first few months of driving (McCartt, Mayhew, Braitman, Ferguson, & Simpson, 2009). While skill deficits are likely to contribute to this crash risk among young drivers, propensity to take risks and violate safe driving laws and conventions also make strong contributions (Blows, Ameratunga, Ivers, Lo, & Norton, 2005; Rowe, Roman, McKenna, Barker, & Poulter, 2015). Road traffic violations are more strongly correlated with crash involvement in younger than older drivers (de Winter & Dodou, 2010).

The concept of violations includes a number of separate, though correlated, risky behaviours (e.g., Reason, Manstead, Stradling, Baxter, & Campbell, 1990). Evidence shows that speeding is a risk factor for crash involvement (Aarts & van Schagen, 2006). Desire to drive faster than is safe for road conditions is a component of many other violations including tailgating, crossing red lights and dangerous overtaking. Other well documented risk factors include driving under the influence of alcohol (Fell & Voas, 2014), while using a mobile phone (Ferdinand & Menachemi, 2014) and while sleepy (Garbarino, Nobili, Beelke, De Carli, & Ferrillo, 2001). Young drivers are particularly likely to engage in violations (Reason et al., 1990). Their sleep is more commonly disturbed (Lyznick, Doege, Davis, & Williams, 1998) and their driving may be more vulnerable to sleep disruption (Groeger, 2006).

A recent study applied growth curve modelling to violation data repeatedly measured over the first three years of driving (Roman, Poulter, Barker, McKenna, & Rowe, 2015). This study identified three latent classes of driver who followed trajectories of consistently high, medium or low levels of violations across the study period. This suggests that the key

58 determinants of risky driving behaviour develop very early in driving or are in place before
59 driving starts.

60 A number of sources of evidence highlight that the attitudes underlying violating
61 behaviour develop during pre-driving. Pre-driving is defined here as the period before
62 independent driving on public roads. In the UK pre-drivers include people without a driving
63 licence and provisional licence holders who can only drive on public roads for the purposes
64 of training, under the supervision of a fully licensed driver. Waylen and McKenna (2008)
65 showed that correlates of risky attitudes among 11-16 year old pre-drivers were similar to
66 those in independent drivers in that they were riskier in males than females and were related
67 to social deviance and sensation seeking. Longitudinal studies show pre-driving attitudes
68 predict post-licence behaviour. Mann and Sullman (2008) found pre-driving speeding
69 intentions predicted violation behaviours (r=.28) when the sample was driving independently
70 12 months later. Rowe, Maughan, Gregory and Eley (2013) reported that violations were
71 predicted by attitudes to speeding in learners (r=.33) and non-drivers (r=.13) measured three
72 years earlier.

73 Effective pre-driving interventions are required to reduce the elevated crash rates
74 observed in the first few months of driving. This may offer the opportunity to influence
75 driving behaviours before they become automated (Harre, Brandt, & Dawe, 2000). A further
76 advantage is that intervention participation can be mandatory in the licencing process.
77 Current evidence indicates that: (a) attitudes to speeding become riskier during the transition
78 from pre-driver to full driver, a tendency that interventions must counter; and (b) attitudes to
79 other violations (e.g., using the horn to indicate displeasure) are safer in independent drivers
80 than pre-drivers, a trend that interventions must enhance (Helman, Kinnear, McKenna,
81 Allsop, & Horswill, 2013; Rowe, Andrews, & Harris, 2013; Rowe, Maughan, et al., 2013).

Many interventions using different forms of delivery and targeting various attitudes and behaviours have been applied to pre-drivers with little evidence of efficacy. The literature contains reports of interventions with little or no effect or that had unintended negative consequences (Glendon, McNally, Jarvis, Chalmers, & Salisbury, 2014; Poulter & McKenna, 2010; Roberts & Kwan, 2006). This problem is not peculiar to pre-drivers; interventions for drivers are also often ineffective (Ker et al., 2003). Road safety interventions are often based on presenters' intuitions rather than psychological theory, although theory-based interventions are likely to be more effective than atheoretical ones (Michie, Rothman, & Sheeran, 2007). A recent meta-analysis of internet-based interventions across a range of health behaviours (Webb, Joseph, Yardley, & Michie, 2010) found that those based on the Theory of Planned Behaviour (TPB; Ajzen, 1991) showed larger effects than interventions based on other theories and those without theoretical foundation.

The TPB has often been employed to understand the psychological antecedents of health related behaviours to inform intervention design (Ajzen, 2013). For example, a recent meta-analysis reported that the TPB accounted for 44% of the variance in intentions and 19% of behavioural variance across 237 prospective empirical tests (McEachan, Conner, Taylor, & Lawton, 2011). The TPB proposes that intention is the most proximal determinant of behaviour and that intentions are themselves based upon (1) attitudes (positive/negative evaluations of the behaviour), (2) subjective norms (perceived social pressure regarding the behaviour) and (3) perceived behavioural control (perceived ease/difficulty of controlling the behaviour). Each of these components is posited to summarise sets of salient beliefs. Underlying attitudes are behavioural beliefs about likely behavioural consequences; for example believing that speeding means quicker journeys might be one of a set of behavioural beliefs underlying a positive attitude towards speeding. Similarly, sets of normative beliefs about the perceived opinions of significant others are proposed to underlie subjective norms,

and sets of control beliefs about factors that facilitate or inhibit behaviour to underlie perceived behavioural control.

Studies have demonstrated that TPB components effectively predict driving violations. For example, the TPB components have been found to predict speeding intentions in drivers and motorcyclists (e.g., Chorlton, Conner, & Jamson, 2012; Conner et al., 2007; Elliott, Armitage, & Baughan, 2007; Parker, Manstead, Stradling, & Reason, 1992). Longitudinal data have shown that change in the TPB components predicts change in speeding intentions, providing increased confidence that the TPB components cause intentions (Elliott, 2012). The TPB components have also been shown to underlie intentions regarding other violations including drink-driving (Moan & Rise, 2011; Parker et al., 1992) and mobile phone use (Gauld, Lewis, & White, 2014; Nemme & White, 2010).

A subset of TPB studies has examined drivers' beliefs regarding speeding (Chorlton et al., 2012; Elliott, Armitage, & Baughan, 2005; Parker et al., 1992) and drink-driving (Parker et al., 1992). Across these studies important behavioural beliefs have included arriving at destinations more quickly, feeling exhilarated, greater fuel usage, and increased crash likelihood. Identified normative beliefs include disapproval from family, friends, police and other road users. Salient control beliefs have addressed road conditions, time pressure and the behaviour of other drivers. Two studies have developed effective interventions to change the beliefs identified via the TPB, thereby reducing violation intentions in drivers with a range of experience (Elliott & Armitage, 2009; Parker, Stradling, & Manstead, 1996).

This paper applies the TPB to guide identification of pre-driver beliefs underlying intentions to drive over the speed limit, while over the legal alcohol limit, talking on a hand-held mobile phone and feeling very tired. The TPB has not previously been applied to identify the beliefs underlying risky intentions in pre-drivers. Given that pre-drivers cannot

actually violate, we focus on intentions to violate as our outcome measure. This approach is supported by evidence that intentions are strong predictors of behaviour. In a meta-analysis of 185 studies, the intention-behaviour correlation was .47 (Armitage & Conner, 2001). A meta-analysis of 47 experimental studies showed that manipulating intentions has a significant impact on subsequent behaviour (d=.36, Webb & Sheeran, 2006). Drivers' speeding intentions correlate with self-reported behaviour, r=.67 to .76 (Elliott, Armitage, & Baughan, 2003; Elliott et al., 2007) and with speeding in both real driving, r=.41, and in a simulator, r=.48 (Conner et al., 2007).

The present study has two phases. In a qualitative belief elicitation study, pre-drivers identified behavioural, normative and control beliefs underlying violations. Next, a quantitative study assessed the extent to which the modal salient beliefs identified in phase 1 were associated with components of the TPB, and which TPB components were most strongly associated with intentions to engage in the risky driving behaviours once a licence was awarded.

Method

Elicitation Study

Sixty students from a Yorkshire sixth form college participated in the elicitation study. They completed the study in a classroom session under the supervision of a college tutor. Their mean age was 16.6 years (range 16-18 years), 53% were female and 85% reported their ethnic origin as White British. Fifty-three per cent had no driving licence, which means they were prohibited from driving on public roads under any circumstances and 47% held a provisional licence that allows supervised driving for training purposes. Students were randomised to answer questions about behavioural, normative and control beliefs regarding

one of driving over the speed limit (N=17), driving while talking on a hand-held mobile phone (N=16), driving whilst feeling very tired (N=12) and driving while over the legal alcohol limit (N=15).

Following the standard method for TPB belief elicitation studies (Ajzen, 2013; Conner & Sparks, 2015) we elicited behavioural beliefs in questionnaires that asked the participants what they believed (a) to be the advantages, (b) to be the disadvantages (c) they would like or enjoy and (d) would dislike or hate about a target behaviour. Normative beliefs were elicited by asking (e) "Which individuals would approve (i.e., think it was a good idea)?", (f) "Which individuals would disapprove (i.e., think it was a bad idea)?", and (g) "Are there any other individuals or groups of people who would approve or disapprove of you driving over the speed limit?". Control beliefs were probed by asking "What things (i.e., factors or circumstances)?" would make the target behaviour (h) more and (i) less likely and (j) whether there were other things that would make the target behaviour more or less likely. Two raters independently coded the generated beliefs. Coding agreement ranged from 89% to 95% across the four violations studied. Commonly identified beliefs (identified by more than 3 participants), were used to populate the belief questionnaires in the main study (see Tables 1-4).

Main Study

Participants and procedure

There were 294 participants from five Yorkshire schools and sixth form colleges. Questionnaires were completed in classroom settings under the supervision of school/college tutors. The average age was 17.06 (SD = 0.68, range 16-19) and 62% were female. Seventy-eight per cent of the sample identified themselves as White British with the remainder identifying ethnicities including Black African (3%) and Pakistani (3%). Forty-six per cent

did not have a driving licence and 54% held provisional licences. Participants were randomised to answer questions regarding one of the four violations targeted: driving over the speed limit (N=77), driving while over the legal alcohol limit (N=72), driving while talking on a hand-held mobile phone (N=77) and driving whilst feeling very tired (N=68). Participants provided informed consent and all study procedures, including the belief elicitation study, were approved by the Ethics Committee, Department of Psychology, University of Sheffield.

Measures

Beliefs

The belief questions in the main study were based on the beliefs identified in the elicitation study. The behavioural beliefs were presented as statements. Participants rated how likely they thought each statement (e.g., Driving over the speed limit would increase my chances of injuring other road users) was to be true on a 7 point scale anchored Unlikely - Likely. Normative beliefs were presented as statements about different groups of people that might approve or disapprove of engagement in each violation (e.g., My parents think that I should/should not drive whilst talking on a hand-held mobile phone) on a 7 point scale anchored Think I should – Think I should not. Scores were reversed so that high scores indicated greater violation approval. Control beliefs were presented as statements about how situations might affect the likelihood of engaging in the violations (e.g., Having no alternative way to get home). Participants rated these on a seven point scale anchored Less likely – More likely. These items were reverse scored so that higher scores indicated less behavioural control.

Components of the Theory of Planned Behaviour

The components of the TPB (attitudes, subjective norms, perceived behavioural control) were measured using the standard questions from the literature (Conner & Sparks, 2015). In this approached each construct is probed with a set of defined items, which tap overlapping but distinct aspects of the construct. The overall score for each TPB component is calculated as the mean of the item-set. Taking the mean provides an index of the composite construct and reduces the impact of item-specific measurement error on the construct score. Cronbach's alpha is calculated to check that the constituent items are measuring the same construct. Alpha values range between 0 and 1 with higher scores indicating greater internal consistency.

Attitudes

Attitudes to the target behaviours were measured as the mean of four semantic differential items rated on seven point scales. These asked whether the target behaviour would be (1) Pleasant – Unpleasant, (2) Harmful – Beneficial, (3) Negative – Positive, and (4) Wise – Foolish. Items were coded so that higher scores indicated riskier attitudes. Cronbach's alpha reliabilities ranged from .83 to .86 across the four target behaviours.

Subjective Norms

Subjective norms regarding the target behaviours were measured as the mean of two items, each rated on a seven point scale, e.g., (1) People who are important to me think I should/should not drive over the speed limit and (2) People who are important to me would approve/disapprove of me driving over the speed limit. The poles were labelled Think I should – Think I should not and Would approve – Would disapprove for these items respectively. These items were coded so that higher scores indicated greater approval for violating. Alpha reliabilities ranged from .58 to .72 across the four target behaviours.

Perceived Behavioural Control

Perceived behavioural control was measured using the mean of four items addressing (1) How much control would you have over whether or not you would drive over the speed limit? with scale poles labelled Complete control – No control, (2) I would have complete control over whether or not I would drive over the speed limit with scale poles labelled Agree – Disagree, (3) If I wanted to, driving over the speed limit would be… with scale poles labelled Easy – Difficult and (4) If I wanted to, I could easily drive over the speed limit with scale poles labelled Likely – Unlikely. High scores indicated more difficulty in controlling the behaviour. Alpha reliabilities ranged from .48 to .78 across the four target behaviours.

Intention

Intention was measured as the mean of three items; (1) How likely is it that you would drive over the speed limit? (Likely – Unlikely) (2) I would be very likely / unlikely to drive over the speed limit... (Very likely – Very unlikely) and (3) How willing would you be to drive over the speed limit? (Very willing – Not at all willing). Items were recoded so that higher scores indicated riskier intentions. Alpha ranged from .64 to .80 across the four target behaviours.

Analysis

There were many moderate and strong correlations within the sets of behavioural, normative and control beliefs elicited. Therefore we conducted exploratory factor analyses to combine related beliefs into scales. Many belief variables were non-normally distributed. Therefore we analysed them as ordinal scales using Geomin rotation, allowing correlated factors to be extracted, in MPlus 7.11 (Muthen & Muthen, 2013). The only exception was the control beliefs regarding driving while tired where the Mplus models would not converge. Therefore

a principal component factor analysis with promax rotation was conducted in Stata 10.1 (StataCorp, 2007) for these items. Factor solutions were primarily chosen based on the scree plot and factor interpretability, with cross-loading items minimised. We then formed scales by adding up the scores of high loading items (>.5), the reliability of which were examined using Cronbach's alpha. Regression models guided by the TPB identified the extent to which behavioural beliefs predicted attitudes, normative beliefs predicted subjective norms and control beliefs predicted perceived behavioural control. We also fitted models to identify the extent to which attitudes, subjective norms and perceived behavioural control predicted intentions to drive riskily.

Results

Exploratory Factor Analyses of Belief Variables

Driving over the speed limit: The commonly identified beliefs from the elicitation study, and the results of the factor analyses conducted on the quantitative items formed from these beliefs, are shown in Table 1. Two factor models provided good fits to the behavioural, normative and control beliefs. Factor structure was interpretable with the minor exception of one cross-loading control belief item. This item was omitted from both scales. Items addressing dangers of speeding, such as the chances of injuring others loaded onto one behavioural beliefs factor. The other represented advantages of speeding, including "looking cool" and arriving more quickly. The normative belief analysis identified separate factors comprising disapprovers (e.g., the police) and approvers (e.g., young people) of speeding. The two control beliefs factors separated items that formed pressures for speeding (e.g., being in a rush or an emergency) from those that inhibited speeding (e.g., weather conditions). In all cases correlations between factors were modest. Alpha analyses indicated that summing the high loading items generated reliable scales.

272

273 Table 1. Factor analyses of beliefs regarding driving over the speed limit

Belief	Factor 1*	Factor 2*
Behavioural beliefs		
Driving over the speed limit would…	Dangers	Advantages
…increase my chances of injuring other road users	.99	
…increase my chances of injuring myself	.97	
…increase my chances of trouble with the police	.88	
…increase my chances of having an accident	.87	
…annoy other road users	.57	
…make me look good/cool		.83
…give me a thrill		.78
…allow me to get to my destination quicker		.62
Factor correlation = -.08	α=.89	α=.71
Normative beliefs		
…think that I should/should not driver over the speed limit	Disapprovers	Approvers
Police / Other authorities…	.97	
Older people…	.93	
Sensible people…	.90	
Most people…	.85	
My family…	.81	
My friends…	.65	
People who enjoy speeding…		.82
Young people…		.70
Men…		.67
People such as chavs…		.50
Factor correlation = .16	α=.89	α=.69
Control beliefs		
…would make driving over the speed limit less/more likely	Pressures	Inhibitors
Being in a rush…	.75	
Being in an emergency…	.83	
Certain weather conditions (e.g. rain, fog) …		.92

Having passengers in my car…		.84
The presence of police / speed cameras…		.69
Being with my friends who are encouraging me to speed**…	.58	.59
Certain road conditions (e.g. busy traffic)…		.51
Factor correlation = .13	α=.70	α=.77

*Only factor loadings above .5 are displayed

**Cross-loading item omitted from both scales

Driving while over the legal alcohol limit: Two factor models were again selected for all belief types (Table 2). Behavioural beliefs were separated into negatively correlated factors representing the dangers (e.g., increased accident risk) and advantages (e.g., give me a thrill) of driving under the influence of alcohol. Normative beliefs separated into disapprovers (e.g., my family) and approvers (e.g., "chavs"[1]). Control beliefs were separated into pressures to encourage driving under the influence (e.g., an emergency) and inhibitors (e.g., the presence of police). Scales based on high loading items had acceptable reliabilities.

[1] "Chav" is slang for an antisocial young person

285 Table 2. Factor analyses of beliefs regarding driving while over the legal alcohol limit

Belief	Factor 1*	Factor 2*
Behavioural beliefs		
Driving while *over the legal alcohol limit would…*	Dangers	Advantages
…increase my chances of hurting other road users	.99	
…increase my chances of injuring myself	.95	
…increase my chances of having an accident	.92	
…impair my driving performance (e.g. poor judgement, slow reactions etc.)	.90	
…increase my chances of losing control of the car	.87	
…be fun and give me a thrill		.94
…put me in a good mood		.89
…give me an advantage over other road users		.72
…be more convenient for me		.60
Factor correlation = -.33	α= .94	α=.85
Normative beliefs		
...think that I should/should not drive whilst over the legal alcohol limit	Disapprovers	Approvers
My family…	.99	
My parents…	.98	
Other road users…	.96	
Sensible people…	.95	
Most people…	.85	
My friends…	.81	
The police/authorities…	.92	
People such as chavs…		.92
People who have a drinking problem…		.77
Foolish people (e.g. idiots)…		.78
Factor correlation = .05	α=.92	α=.82
Control beliefs		
...would make driving whilst over the legal alcohol limit less/more likely	Pressures	Inhibitors
Having no alternative way to get home…	.83	
Having friends with me…	.71	
Being in an emergency situation…	.59	

The presence of the police…		.96
Knowing a victim of a road accident…		.93
Having thought about the risks…		.82
Having passengers in the car…**	.58	.73
Factor correlation = -.03	α=.68	α=.88

*Only factor loadings above .5 are displayed

**Cross-loading item omitted from both scales

Driving whilst talking on a hand-held mobile phone: Table 3 shows that there were two behavioural beliefs factors; dangers (including reduced control of car) and advantages containing two items (allow me to talk with people and to multi-task). Although the normative beliefs factor analysis identified two factors, the second factor had an eigenvalue of only 1.12, there were cross-loading items, and a substantial correlation between the factors (r=.64). Therefore a one factor solution was preferred. All items loaded positively onto the single factor representing disapprovers of driving while using a phone. Two control beliefs factors were identified: pressures encouraging phone use (e.g., an emergency) and inhibitors to prevent it (e.g., driving near pedestrians). Alpha reliabilities were acceptable for constructed scales.

Table 3. Factor analyses of beliefs regarding driving whilst talking on a hand-held mobile phone

Belief	Factor 1*	Factor 2*
Behavioural beliefs		
Driving whilst talking on a hand-held mobile phone *would…*	Dangers	Advantages
…allow me to keep in touch / talk with people		.95
…allow me to multi-task		.58
…reduce my control of the car	.89	

…increase my chances of having an accident	.88	
….mean diverting my attention from the road	.88	
…increase my level of distraction	.88	
…increase the chances of trouble with the police	.75	
Factor correlation = .02	α=.86	α=.67
Normative beliefs		
...think that I should/should not drive whilst talking on a hand-held mobile phone	Disapprovers	
Older people…	.93	
Sensible people…	.90	
My parents…	.89	
Police and other authorities…	.82	
Most people…	.79	
Young people…	.57	
Foolish people (e.g. idiots)…		
	α=.77	
Control beliefs		
...would make driving whilst talking on a hand-held mobile phone less/more likely	Pressures	Inhibitors
Needing to make an important or urgent call…	.93	
Receiving an important call…	.77	
Being in an emergency situation…	.51	
Driving on a quiet or remote road…		
Driving near pedestrians or a school…		.93
Police presence…		.95
Knowing of road accidents involving drivers using mobile phones…		.91
Driving in busy traffic…		.67
Factor correlation = .10	α=.71	α=.87

*Only factor loadings above .5 are displayed

Driving while feeling very tired: As shown in Table 4, we preferred a one factor behavioural beliefs solution as, in the two factor model, the second factor eigenvalue was only 1.08, a number items loaded onto both factors and there was a strong correlation between the factors

(r=.59). The single factor focussed on the dangers of driving while tired, including poor concentration. There was a single subjective norms factor including disapprovers of driving while tired. The principal components factor analysis of control beliefs identified two components. Two items loaded onto a pressures to drive while tired factor (needing to drive early in the morning and late at night). Three items loaded onto an inhibitors factor including having no real need to drive. All alphas were above .60 for the constructed scales.

Table 4. Factor analyses of beliefs regarding driving whilst feeling very tired

Belief	Factor 1*	Factor 2*
Behavioural beliefs		
Driving whilst feeling very tired…	Dangers	
…impair my driving performance (e.g. poor concentration)	.94	
…increase my chances of having an accident	.88	
…increase my chances of hurting other road users	.88	
…result in me having slower reactions to events on the road	.83	
…increase my chances of falling asleep at the wheel	.77	
…increase the probability of me dying	.69	
…mean I had to invest greater effort to stay awake	.67	
…get me to my destination quicker than using public transport		
…give me an advantage over other road users***	.71	
	α= .91	
Normative beliefs		
…think that I should/should not drive whilst feeling very tired	Disapprovers	
The police/authorities…	1.00	
Sensible people…	.90	
Most people…	.83	
Older people…	.77	

Young people…	.66	
Foolish people (e.g. idiots)…****		
	α= .88	
Control beliefs**		
…*would* make driving whilst feeling very tired less/more likely	Pressures	Inhibitors
Needing to drive in the early morning…	.90	
Needing to drive late at night…	.87	
Having no real need to make a journey…		.81
Being in an emergency situation…***		.77
Fear of having an accident…		.66
Factor correlation = .09	α=.70	α=.61

*Only factor loadings above .5 are displayed

**Factor results calculated using Principal Factor Analysis with promax rotation

***Item reverse scored

**** Item dropped as preventing model convergence

Theory of Planned Behaviour Analyses

As Table 5 shows, attitudes, subjective norms and perceived behavioural control jointly accounted for substantial proportions of variance in intentions regarding all behaviours (R^2 range .41 - .69). Attitudes were significant independent predictors of intention for all behaviours, whereas subjective norms and perceived behavioural control predicted intention to speed and use a mobile phone, but did not predict intention to drive under the influence of alcohol or while tired.

Table 5. β coefficients (and 95% Confidence Intervals) from multiple regression models predicting risky intentions from attitudes, subjective norm and perceived behavioural control

	Driving…			
Predictor[1]	Over the speed limit	Over the legal alcohol limit	While talking on a hand-held mobile phone	While feeling very tired
N	77	72	77	68
R^2	.69***	.68***	.63***	.41***
Attitudes	.53*** (.35, .70)	.72*** (.50, .94)	.53*** (.33, .73)	.49** (.21, .78)
Subjective norms	.29** (.12, .46)	.08 (-.13, .29)	.19* (.02, .37)	.14 (-.14, .42)
Perceived behavioural control	.19** (.05, .33)	.10 (-.05, .26)	.17* (.01, .33)	.13 (-.10, .34)

[1]Age and sex were entered as covariates into all models.

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

As Table 6 shows, behavioural beliefs regarding dangers predicted attitudes towards all behaviours. Behavioural beliefs regarding advantages predicted attitudes to speeding and driving under the influence of alcohol. Normative beliefs about disapprovers of violating predicted subjective norms for all behaviours. Where normative beliefs about approvers of violation were identified (speeding and driving under the influence of alcohol), they did not predict subjective norms independently from normative beliefs regarding disapprovers. Inhibitory control beliefs predicted perceived behavioural control for speeding, with no significant predictors of perceived behavioural control identified for the other behaviours.

340 Table 6. β coefficients (and 95% Confidence Intervals) from multiple regression models predicting attitudes, subjective norms and perceived
341 behavioural control from the beliefs hypothesised to underlie these constructs according to the Theory of Planned Behaviour. Age and sex were
342 entered as covariates into all models.

Driving…	Behavioural Beliefs	Attitudes	Normative Beliefs	Subjective norms	Control Beliefs	Perceived behavioural control
…Over the speed limit		R^2=.54***		R^2=.46***		R^2=.20**
	Dangers	-.40*** (-.56, -.24)	Disapprovers	.58*** (.39, .77)	Pressures	.08 (-.14, .31)
	Advantages	.58*** (.42, .75)	Approvers	.15 (-.04, .33)	Inhibitors	-.33** (-.56, -.10)
…While over the legal alcohol limit		R^2=.28***		R^2=.19**		R^2=.04
	Dangers	-.32** (-.55, -.09)	Disapprovers	.43*** (.20, .65)	Pressures	.02 (-.23, .27)
	Advantages	.28* (.06, .50)	Approvers	-.16 (-.39, .06)	Inhibitors	.18 (-.07, .43)
…While talking on a hand-held mobile phone		R^2=.27***		R^2=.22***		R^2=.07
	Dangers	-.44*** (-.64, -.25)	Disapprovers	.45*** (.23, .66)	Pressures	.18 (-.06, .43)
	Advantages	.17 (-.03, .36)			Inhibitors	-.10 (-.36, .16)

…While feeling very tired		R^2=.42***		R^2=.45***		R^2=.07
	Dangers	-.64*** (-.83, -.44)	Disapprovers	.64*** (.45, .84)	Pressures	.01 (-.24, .26)
					Inhibitors	.13 (-.12, .38)

Discussion

Application of the TPB to pre-driver intentions

This study used the TPB to identify pre-driving beliefs that underlie intentions to engage in four driving violations. From the perspective of the TPB, the key beliefs for interventions to target are those that significantly predict TPB components that in turn significantly predict intentions. In combination the TPB components were strong predictors of violation intentions, explaining between 63% and 69% of the variance for driving over the speed limit, driving above the legal alcohol limit and driving while talking on a hand held mobile phone, and 41% in driving while feeling very tired. This compares to an average 44% of variance explained in intentions by TPB variables across 206 studies (McEachan et al., 2011). In the current study, attitudes were strong predictors of intentions for all behaviours while subjective norms and perceived behavioural control were significant, though weaker, independent predictors regarding speeding and phone use.

For all four violations, behavioural beliefs explained substantial proportions of variance in attitude: 54% regarding speeding intentions, 42% for tiredness, 28% for alcohol use and 29% for mobile phone distraction. There were some notable similarities in the important beliefs identified across behaviours. A set of beliefs regarding risk of accident and/or injury predicted attitudes towards all violations. Specific negative behavioural beliefs were also identified. Impaired driving performance, such as diverted attention and slowed reactions, and risk of loss of vehicle control were identified for alcohol use, mobile phone use and tiredness. The risk of annoying other drivers was identified regarding speeding. Separate behavioural belief factors regarding the advantages offered by violating were identified for speeding and alcohol use. The practical advantages of violating were highlighted; arriving

faster for speeding and convenience for driving under the influence of alcohol. Regarding speeding, a feeling of thrill and looking good or "cool" was also highlighted.

Subjective norms predicted intentions to speed and to use a mobile phone. Significant others who disapprove of violations were prominent including the police as well as family and friends, older and "sensible" people. Perceived behavioural control predicted intentions to speed and to use a mobile phone. For speeding the significant control beliefs included items that might reduce likelihood of speeding. These included weather and road conditions, the presence of speed cameras and having passengers in the car. The identified control beliefs did not predict perceived behavioural control of using a mobile phone.

Informing road safety interventions

The current results add to the information currently available to develop road safety interventions for pre-drivers. Specifically, intervention designers can focus on bolstering negative beliefs about risky driving (e.g., speeding increases injury risk) and countering the positive beliefs (e.g., speeding substantially reduces journey times). Such belief modification would be predicted to lead, in turn, to less frequent violations during future independent driving. Prospective studies, ideally involving a randomised intervention to change beliefs, will be needed to test this hypothesis.

A number of the beliefs identified here are often addressed in road safety material aimed at both pre-drivers and fully qualified drivers. For example, these include the behavioural beliefs that violations increase risk of crash and injury, that mobile phone use causes distraction, that alcohol slows reactions, and that the police disapprove of risk taking which may lead to traffic citation. Our results may therefore be seen as an impetus to continue with these efforts, and in particular provide a novel basis for their extension to pre-driver audiences. However, some of the other beliefs identified as important predictors in our

study suggest further targets for intervention. The belief that speeding will result in shorter journey times could be addressed with demonstrations that speeding motorists are likely to save relatively little time on many journeys. A body of literature has addressed biases in assessment of time savings relative to speed (e.g., Svenson, 2008) and interventions developed there could be applied in pre-driving education. Beliefs that risk-taking looks good and is enjoyable may be addressed with counter-examples in which risk-taking leads to negative consequences such as disapproval from passengers, embarrassing road-side discussions with police or unattractive damage to vehicles. Beliefs about family and disapproval of speeding and mobile phone use may be enhanced by making this a focus of road safety material.

Road safety education packages addressing the beliefs identified here may take various forms including media campaigns, on- and off-line literature, and live small- and large-group educational programmes. For example, media-based packages often graphically depict car crashes resulting from speeding, alcohol consumption, distraction or fatigue. Interventions of this form are likely to have high face validity as bolstering the behavioural beliefs that risky behaviour increases the risk of crash and injury; beliefs that we have identified as important predictors of intentions to violate in this study. Indeed, face validity is a necessary component for road safety intervention; both the presenters and audience must view the intervention as acceptable and appropriate for the intervention to be viable for large-scale adoption. However, face validity is not sufficient; interventions must also demonstrate objective evidence that they can change their attitudinal and behavioural targets, ideally in randomized controlled trials (RCT).

A body of research has begun to address links between parent and child driving and the concept of family culture for road safety has been developed (Taubman-Ben-Ari & Katz-

Ben-Ami, 2012). A number of interventions for teen driver road safety have targeted parental behaviours (Curry, Peek-Asa, Hamann, & Mirman, 2015). This approach may be particularly well suited to intervening to improve the pre-driver beliefs identified in our study.

Evaluating road safety interventions for pre-drivers

Whatever form interventions to address pre-driving beliefs take, evidence that they can reduce future crash rates would prove particularly compelling. However, the rarity of crashes and plethora of other factors involved in their causation, such as exposure and the behaviour of other road users, may make gathering evidence of this sort unfeasible (Hutchinson & Wundersitz, 2011). Instead, intervention effectiveness may be tested in studies that measure "variables that can be objectively observed and are closely related to safety" (Hutchinson & Wundersitz, 2011 page 235). Therefore, for pre-drivers, measures are required that can be answered by people who do not drive but that have been demonstrated to correlate with safety-critical aspects of behaviour in drivers. Examples include the Attitudes to Driving Violations Scale (West & Hall, 1997) which, when assessed in learner drivers predicts post-license driving violations (Rowe, Maughan, et al., 2013) and the Violations Willingness Scale, which correlates strongly with driving violations when measured in drivers (Rowe, Andrews, et al., 2013).

As discussed in the introduction, there is currently little RCT evidence for the effectiveness of pre-driver road safety interventions. However, there is evidence that TPB-informed interventions may be effective in encouraging other health behaviours, such as reduced alcohol consumption and smoking (Webb et al., 2010). We also noted that two studies reported effective TPB based interventions with driving. Elliott and Armitage (2009) found that messages regarding control beliefs were key to mediating the effect of their intervention. Conversely, Parker et al. (1996) found that targeting normative beliefs was most

effective. Although not directly comparable, the strength of the association between attitudes and intention is striking in the current study and indicates that behavioural beliefs may be a particularly attractive initial target for RCT studies of interventions for pre-drivers.

Limitations

These results must be considered in the context of a number of limitations. First, the reliability of some of the assessed TPB variables was lower than desirable. It is likely that measuring these constructs using a small number of items contributed to this issue. Using more items might have improved reliability but this would also have contributed to participant fatigue. Second, the focus on pre-drivers meant that our outcome measures were intentions to drive riskily in the future rather than risky driving behaviour. Studies following up from pre-driving to actual driving behaviour months or years later are clearly of great value in identifying key pre-driving beliefs and attitudes. Currently these are rare in the literature. We believe that our results provide a useful guide to the pre-driving beliefs that are likely to be important in safe driving that can inform intervention at the present time. Our results and approach may also inform the design of longitudinal studies that can track associations of pre-driving beliefs and post-driving behaviours across the driver training process.

Implications

The early driving period is an attractive target for road safety intervention in that crash risk is very high in the first few months after beginning independent driving (McCartt et al., 2009). Therefore, interventions that are effective for only a few months could have a strong road safety impact. This situation contrasts with many other health behaviours, such as alcohol use and smoking, where interventions need to be effective for much longer periods to have meaningful public health impact. Combined with the political and public appetite for

462 educational solutions to the novice driver problem (Williams & Ferguson, 2004), this
463 provides considerable impetus for the design of theoretically informed road safety
464 interventions. We believe that interventions that aim to modify the pre-driving beliefs
465 identified here offer the potential to impact upon the substantial public health problem of
466 novice driver crash involvement.

467

Acknowledgements

This work was supported by a Higher Education Innovation Fund Knowledge Transfer Grant. Many thanks to South Yorkshire Safer Roads Partnership for assistance in running the project.

References

Aarts, L., & van Schagen, I. (2006). Driving Speed and the Risk of Road Crashes: A Review. Accident Analysis and Prevention, 38(2), 215-224.

Ajzen, I. (1991). The theory of planned behaviour. Organizational Behaviour and Human Decision Processes, 50, 179-211.

Ajzen, I. (2013). Constructing a Theory of Planned Behavior Questionnaire.

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. British Journal of Social Psychology, 40, 471-499. doi:10.1348/014466601164939

Blows, S., Ameratunga, S., Ivers, R. Q., Lo, S. K., & Norton, R. (2005). Risky driving habits and motor vehicle driver injury. Accident Analysis and Prevention, 37(4), 619-624. doi:10.1016/j.aap.2005.03.003

Chorlton, K., Conner, M., & Jamson, S. (2012). Identifying the psychological determinants of risky riding: An application of an extended Theory of Planned Behaviour. Accident Analysis and Prevention, 49, 142-153. doi:10.1016/j.aap.2011.07.003

Conner, M., Lawton, R., Parker, D., Chorlton, K., Manstead, A. S. R., & Stradlings, S. (2007). Application of the theory of planned behaviour to the prediction of objectively assessed breaking of posted speed limits. British Journal of Psychology, 98, 429-453. doi:10.1348/000712606x133597

Conner, M., & Sparks, P. (2015). Theory of Planned Behaviour and Health Behaviour. In M. Conner & P. Norman (Eds.), Predicting Health Behaviour. Buckingham: Open University Press.

Curry, A. E., Peek-Asa, C., Hamann, C. J., & Mirman, J. H. (2015). Effectiveness of Parent-Focused Interventions to Increase Teen Driver Safety: A Critical Review. Journal of Adolescent Health, 57(1), S6-S14. doi:10.1016/j.jadohealth.2015.01.003

497 de Winter, J. C. F., & Dodou, D. (2010). The Driver Behaviour Questionnaire as a predictor
498 of accidents: A meta-analysis. Journal of Safety Research, 41(6), 463-470.
499 doi:10.1016/j.jsr.2010.10.007
500 Department for Transport. (2013). Reported Road Casualties Great Britain: 2012. Retrieved
501 from London
502 Elliott, M. A. (2012). Testing the capacity within an extended theory of planned behaviour to
503 reduce the commission of driving violations. Transportmetrica, 8(5), 321-343.
504 doi:10.1080/18128602.2010.502548
505 Elliott, M. A., & Armitage, C. J. (2009). Promoting drivers' compliance with speed limits:
506 Testing an intervention based on the theory of planned behaviour. British Journal of
507 Psychology, 100, 111-132. doi:10.1348/000712608x318626
508 Elliott, M. A., Armitage, C. J., & Baughan, C. J. (2003). Drivers' compliance with speed
509 limits: An application of the theory of planned behavior. Journal of Applied
510 Psychology, 88(5), 964-972. doi:10.1037/0021-9010.88.5.964
511 Elliott, M. A., Armitage, C. J., & Baughan, C. J. (2005). Exploring the beliefs underpinning
512 drivers' intentions to comply with speed limits. Transportation Research Part F-
513 Traffic Psychology and Behaviour, 8(6), 459-479. Retrieved from <Go to
514 ISI>://000233312800006
515 Elliott, M. A., Armitage, C. J., & Baughan, C. J. (2007). Using the theory of planned
516 behaviour to predict observed driving behaviour. British Journal of Social
517 Psychology, 46, 69-90. doi:10.1348/14466605x90801
518 Fell, J. C., & Voas, R. B. (2014). The effectiveness of a 0.05 blood alcohol concentration (
519 BAC) limit for driving in the United States. Addiction, 109(6), 869-874.
520 doi:10.1111/add.12365

Ferdinand, A. O., & Menachemi, N. (2014). Associations between driving performance and engaging in secondary tasks: a systematic review. American Journal of Public Health, 104(3), e39-48. doi:10.2105/ajph.2013.301750

Garbarino, S., Nobili, L., Beelke, M., De Carli, F., & Ferrillo, F. (2001). The contributing role of sleepiness in highway vehicle accidents. Sleep, 24(2), 203-206. Retrieved from <Go to ISI>://000167583200008

Gauld, C. S., Lewis, I., & White, K. M. (2014). Concealing their communication: Exploring psychosocial predictors of young drivers' intentions and engagement in concealed texting. Accident Analysis and Prevention, 62, 285-293. doi:10.1016/j.aap.2013.10.016

Glendon, A. I., McNally, B., Jarvis, A., Chalmers, S. L., & Salisbury, R. L. (2014). Evaluating a novice driver and pre-driver road safety intervention. Accident Analysis & Prevention, 64(0), 100-110. doi:http://dx.doi.org/10.1016/j.aap.2013.11.017

Groeger, J. A. (2006). Youthfulness, inexperience, and sleep loss: the problems young drivers face and those they pose for us. Injury Prevention, 12, 19-24. doi:10.1136/ip.2006.012070

Harre, N., Brandt, T., & Dawe, M. (2000). The development of risky driving in adolescence. Journal of Safety Research, 31(4), 185-194. Retrieved from <Go to ISI>://WOS:000165977400002

Helman, S., Kinnear, N. A. D., McKenna, F. P., Allsop, R. E., & Horswill, M. S. (2013). Changes in self-reported driving intentions and attitudes while learning to drive in Great Britain. Accident Analysis & Prevention, 59(0), 425-431. doi:http://dx.doi.org/10.1016/j.aap.2013.06.038

544 Hutchinson, T. P., & Wundersitz, L. N. (2011). Road safety mass media campaigns: why are
545 results inconclusive, and what can be done? Int J Inj Contr Saf Promot, 18(3), 235-
546 241. doi:10.1080/17457300.2010.540330
547 Ker, K., Roberts, I. G., Collier, T., Beyer, F. R., Bunn, F., & Frost, C. (2003). Strong
548 evidence that advanced and remedial driver education does not reduce road traffic
549 crashes or injuries. Cochrane Database of Systematic Reviews.
550 Lyznick, J. M., Doege, T. C., Davis, R. M., & Williams, M. A. (1998). Sleepiness, driving
551 and motor vehicle crashes. Journal of the American Medical Association, 279, 1908-
552 1913.
553 Mann, H. N., & Sullman, M. J. M. (2008). Pre-driving attitudes and non-driving road-user
554 behaviours: Does the past predict future driving behaviour? In L. Dorn (Ed.), Driver
555 Behaviour and Training: Volume 3. Aldershot, UK: Ashgate.
556 McCartt, A. T., Mayhew, D. R., Braitman, K. A., Ferguson, S. A., & Simpson, H. M. (2009).
557 Effects of Age and Experience on Young Driver Crashes: Review of Recent
558 Literature. Traffic Injury Prevention, 10(3), 209-219.
559 doi:10.1080/15389580802677807
560 McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective
561 prediction of health-related behaviours with the Theory of Planned Behaviour: a
562 meta-analysis. Health Psychology Review, 5(2), 97-144.
563 doi:10.1080/17437199.2010.521684
564 Michie, S., Rothman, A., & Sheeran, P. (2007). Current issues and new direction in
565 Psychology and Health : Advancing the science of behavior change. Psychology &
566 Health, 22(3), 249-253. doi:10.1080/14768320701233582

567 Moan, I. S., & Rise, J. (2011). Predicting intentions not to "drink and drive" using an
568 extended version of the theory of planned behaviour. Accident Analysis and
569 Prevention, 43(4), 1378-1384. doi:10.1016/j.aap.2011.02.012
570 Muthen, L. K., & Muthen, B. O. (2013). MPlus User's Guide. Los Angeles, CA: Muthen &
571 Muthen.
572 Nemme, H. E., & White, K. M. (2010). Texting while driving: Psychosocial influences on
573 young people's texting intentions and behaviour. Accident Analysis & Prevention,
574 42(4), 1257-1265. doi:http://dx.doi.org/10.1016/j.aap.2010.01.019
575 Parker, D., Manstead, A. S. R., Stradling, S. G., & Reason, J. T. (1992). Determinants of
576 intentions to commit driving violations. Accident Analysis and Prevention, 24(2),
577 117-131. doi:10.1016/0001-4575(92)90028-h
578 Parker, D., Stradling, S. G., & Manstead, A. S. R. (1996). Modifying Beliefs and Attitudes to
579 Exceeding the Speed Limit: An Intervention Study Based on the Theory of Planned
580 Behavior1. Journal of Applied Social Psychology, 26(1), 1-19. doi:10.1111/j.1559-
581 1816.1996.tb01835.x
582 Poulter, D. R., & McKenna, F. P. (2010). Evaluating the effectiveness of a road safety
583 education intervention for pre-drivers: An application of the theory of planned
584 behaviour. British Journal of Educational Psychology, 80(2), 163-181.
585 doi:10.1348/014466509x468421
586 Reason, J. T., Manstead, A., Stradling, S., Baxter, J., & Campbell, K. (1990). Errors and
587 Violations on the Roads - a Real Distinction. Ergonomics, 33(10-11), 1315-1332.
588 Retrieved from <Go to ISI>://A1990EH39700012

589 http://www.tandfonline.com/doi/abs/10.1080/00140139008925335?url_ver=Z39.88-
590 2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed

591 Roberts, I. G., & Kwan, I. (2006). School-base education for the prevention of driver crashes.
592 Cochrane Database of Systematic Reviews(2).
593 Roman, G. D., Poulter, D., Barker, E., McKenna, F. P., & Rowe, R. (2015). Novice drivers'
594 individual trajectories of driver behavior over the first three years of driving. Accident
595 Analysis & Prevention, 82(0), 61-69. doi:http://dx.doi.org/10.1016/j.aap.2015.05.012
596 Rowe, R., Andrews, E., & Harris, P. (2013). Measuring risky-driving propensity in pre-
597 drivers: The Violation Willingness Scale. Transportation Research Part F-Traffic
598 Psychology and Behaviour, 19, 1-10. doi:10.1016/j.trf.2013.01.003
599 Rowe, R., Maughan, B., Gregory, A. M., & Eley, T. C. (2013). The development of risky
600 attitudes from pre-driving to fully-qualified driving. Injury Prevention, 19(4), 244-
601 249. doi:10.1136/injuryprev-2012-040551
602 Rowe, R., Roman, G. D., McKenna, F. P., Barker, E., & Poulter, D. (2015). Measuring errors
603 and violations on the road: A bifactor modeling approach to the Driver Behavior
604 Questionnaire. Accident Analysis & Prevention, 74(0), 118-125.
605 doi:http://dx.doi.org/10.1016/j.aap.2014.10.012
606 StataCorp. (2007). Stata Statistical Software: Release 10.1. College Station, TX: Stata
607 Corporation.
608 Svenson, O. (2008). Decisions among time saving options: When intuition is strong and
609 wrong. Acta Psychologica, 127(2), 501-509. doi:10.1016/j.actpsy.2007.09.003
610 Taubman-Ben-Ari, O., & Katz-Ben-Ami, L. (2012). The contribution of family climate for
611 road safety and social environment to the reported driving behavior of young drivers.
612 Accident Analysis and Prevention, 47, 1-10. doi:10.1016/j.aap.2012.01.003
613 Waylen, A. E., & McKenna, F. P. (2008). Risky attitudes towards road use in pre-drivers.
614 Accident Analysis and Prevention, 40(3), 905-911. doi:10.1016/j.aap.2007.10.005

615 Webb, T. L., Joseph, J., Yardley, L., & Michie, S. (2010). Using the Internet to Promote
616 Health Behavior Change: A Systematic Review and Meta-analysis of the Impact of
617 Theoretical Basis, Use of Behavior Change Techniques, and Mode of Delivery on
618 Efficacy. Journal of Medical Internet Research, 12(1), 18. doi:10.2196/jmir.1376
619 Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender bahaviour
620 change? A meta-analysis of the experimental evidence. Psychological Bulletin,
621 132(2), 249-268. doi:10.1037/0033-2909.132.2.249
622 West, R., & Hall, J. (1997). The role of personality and attitudes in traffic accident risk.
623 Applied Psychology-an International Review-Psychologie Appliquee-Revue
624 Internationale, 46(3), 253-264. Retrieved from <Go to ISI>://A1997XL48000004
625 Williams, A. F., & Ferguson, S. A. (2004). Driver education renaissance? Injury Prevention,
626 10(1), 4-7. doi:10.1136/ip.2003.004358

627