

## Drive better, feel better: Examining associations between well-being and driving behaviour in students

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### ABSTRACT

Road transport often presents one of the major safety risks to which individuals are exposed. In the present study, driving behaviour, driving skill, driving hazards and their potential links to well-being were examined in a sample of 224 undergraduate psychology students at Cardiff University. A cross-sectional, online survey measured driving behaviour (e.g., distraction and aggression - derived from the recent work of Smith, 2016) and well-being (positive outcomes, negative outcomes, and positive and negative appraisals) using the Student-WPQ (Williams et al., 2017). Hierarchical multiple regressions demonstrated that poor driving behaviour predicted negative well-being and appraisal, whereas more pro-social driving behaviour was predictive of positive well-being and appraisal. These effects remained significant when established predictors of well-being were covaried. Therefore, this research has identified links between well-being and driving behaviour. While it is acknowledged that the cross-sectional nature of the research makes attribution of causality problematic, it is suggested the identification of potential variables of interest paves the way for further longitudinal enquiry.

**Keywords:** Well-being; driving behaviour; driving hazard; driving skill

### INTRODUCTION

Road transport is often representative of the greatest risk to which individuals are exposed. By way of illustration, there were a reported 22,137 seriously injured casualties on UK roads during 2015, of which 1,732 were fatalities (Department for Transport, 2016) [1]. As well as the obvious concerns surrounding injury and mortality, road traffic collisions (RTCs) cost the UK economy over £15 billion in 2013, with this figure comprising of vehicle and property damage, police costs, and insurance costs (GOV.UK, 2013) [2]. There can be little doubt that the study of transport behaviour is of considerable importance to individuals, businesses and society as a whole.

Undeniably, human factors play a major part in safe transport, and there exists a considerable body of research addressing specific topics in certain areas of transport (e.g., fatigue in long haul truck drivers; see Crizzle et al., 2017 for a review) [3] but there are still considerable gaps in our knowledge to date. Specifically, what is missing is an understanding of the motivation underlying unsafe behaviour. The vast majority of the extant research focuses on factors in isolation, whereas it is clear that a multi-variate approach is essential. Also, it is important to adjust for potential confounding variables which may influence both risk factors and outcomes (e.g., psychosocial factors, demographic variables, lifestyle, and job characteristics). The Driver Behaviour Questionnaire (DBQ; Reason, Manstead, Stradling, Baxter & Campbell, 1990) [4] has

offered empirical evidence that driving behaviour is governed by two psychologically distinct components: errors and violations. Errors reflect performance limits of the driver such as those related to attentional, perceptual and information processing abilities. As a result, the literature is replete with factors contributing to driver error, such as risk-taking, stress, and physical and mental illness, which in turn have been found to predict RTCs (e.g. Smith, 2016) [5]. Fatigue often emerges as the strongest predictor for RTCs and has thus received significant research attention (Bener, Yildirim, Ozkan & Lajunen, 2017) [6]. Violations, on the other hand, represent the style in which the driver *chooses* to drive, (referred to as driving behaviour) and includes actions such as indicating hostility to other drivers and missing warning signs, often affected by driver mood (Parker, Reason, Manstead & Stradling 1995) [7]. Also, drivers are exposed to hazards which perceptibly exacerbate RTC risk, such as excessive motorway driving, and driving for prolonged periods (Smith, 2016) [5]. While driver error may be dealt with using retraining and improved designs of driver interface, it is becoming apparent that a more holistic picture is required in the remit of driving behaviour, which is arguably underpinned by attitudinal dynamics (Parker et al., 1995) [7].

Changing focus, there is an emerging body of literature exploring whether well-being, defined as a dynamic concept that includes subjective, social, and psychological dimensions, as well as health-related behaviours, has a bearing upon driving behaviour, typically from a negative perspective (i.e., lower levels of well-being equating to poorer driving; Hu, Xie, & Li, 2013) [8]. However, what has currently not been accounted for is the role of *driving itself* upon well-being. Given that well-being is known to be affected by other environments, such as the workplace, with this in turn impacting both safety and productivity (e.g. de Cates, Stranges, Blake & Weich, 2014; King & Jex, 2014) [9,10], it is reasonable to suggest that such effects may be observed in drivers. A recent study conducted by Isler and Newland (2017) [11] on undergraduate psychology students found that high levels of life satisfaction and well-being were related to lower levels of driving violations. As there has been a clear link established between the self-reported tendency to commit violations and RTC involvement (Parker et al., 1995) [7], such an insight warrants more detailed exploration.

The well-being of university students has received considerable research attention (e.g. Cameron, 1999; Lee & Yuen Loke, 2005) [12,13] and more recently, high levels of anxiety, stress and depression have been reported in undergraduate students (Bayram & Bilgel, 2008) [14], alongside the core well-being characteristics of coping style, demand, skill, resources and personality identified by the Well-being Process Questionnaire (WPQ; Williams & Smith, 2012) [15]. The WPQ arose from the identification of a gap in the measurement of well-being, given that well-being is a multi-faceted construct which necessitates the inclusion of both positive and negative outcomes (e.g. anxiety and depression, and happiness), positive and negative appraisal (e.g. perceived stress) and individual differences (e.g. self-efficacy, optimism, self-esteem and positive personality). Contemporary research by Williams, Pendlebury, Thomas and Smith (2017) [16] led to the development of the Student Well-being Process Questionnaire (Student WPQ) affording more focused well-being research on this population, with single item questions offering the same predictive validity as multi-item scales. The questionnaire examines predictors of positive well-being, negative mental health and cognitive function. The core variables attributed to the well-being outcomes are similar to those of the WPQ (discussed in detail elsewhere, e.g. Williams & Smith, 2012) [15], however student related circumstances, such as long hours of study, lack of social support, fear of failing, time pressures, challenges to development and social mistreatment are also taken into account. Further, non-direct coping styles, including hostility and wishful thinking, known to impact levels of distress in this population (Tully, 2004) [17] add to this diverse approach to the measurement of student well-being. Alos, the model is flexible in that it allows for the incorporation of new predictors and

outcomes, such that it is possible to utilise the 'core' well-being variables as covariates, allowing one to determine whether any new effects are independent or related to the core variables.

### **Aims and hypotheses**

The purpose of the present study was to examine well-being and driving behaviour in a student population, using driving behaviour measures derived from recent research by Smith (2016) [5] and the Student WPQ (Williams et al., 2017) [16]. Although it is noteworthy at this juncture that the cross-sectional study design does not allow claims of causality, it may afford an insight into key variables which may be of use in further longitudinal enquiry.

As driving behaviour has not been extensively studied in the context of well-being, one needs to assess whether the aforementioned core variables established in the literature are demonstrated in the current sample, affording confidence in any effects detected in the more novel addition of driving behaviour. First, it was hypothesised (in line with the findings of Williams et al., 2017) [16] that positive well-being (positive affect, life satisfaction and happiness) would be predicted by positive personality (high self-efficacy, self-esteem and optimism) low stressors and negative coping and high levels of social support, whereas negative outcomes (anxiety, depression and perceived stress) would be predicted by high conscientiousness, coping and stressor scores and low social support and positive personality scores. Negative appraisals would be predicted by fatigue and perceived stress and positive appraisal by life satisfaction. Second, the study investigated whether well-being (positive or negative), affected driving behaviour, or conversely, whether driving itself impacted on well-being, using a multivariate approach, in which the established well-being variables were held constant and any new effects examined.

## **METHOD**

### **Participants**

The study was approved by the Ethics Committee, School of Psychology, Cardiff University, before the recruitment of participants. Data were collected from 224 undergraduate psychology students at Cardiff University (17.4% male, 82.1% female, 4% other; age range 18-24) recruited via the School's Experiment Management System, (EMS) in return for course credit. There was no similar research that would have aided us to calculate a sample size based on effect sizes. As a result, a relatively large sample size that would allow detection of moderate size effects was recruited. The rationale being this was that should the study fail to reveal any significant relationship between well-being and driving behaviour, one may infer that should such a relationship exist, it would be unlikely to hold any practical significance. Of the sample, 131 participants reported having driven a motor vehicle in the last 12 months.

### **Measures**

The questionnaire used in this study included two sections, the Student WPQ (Williams et al., 2017) [16] and driving behaviour questions adapted from a recent study on driving behaviour by Smith (2016) [5]. The full list of questions is shown in the Appendix. Examples of the questions from each section are given below.

#### ***Well-being:***

Participants were required to indicate on a ten-point Likert scale (1= disagree strongly; 10= agree strongly) their responses to 57 questions concerning their well-being, such as: 'In general, I feel optimistic about the future (for example: I usually expect the best, I expect more good things to happen to me than bad, It's easy for me to relax)' (optimism); 'When I find myself in stressful situations, I look for social support (for example: I talk to someone to get

more information, I ask someone for advice, I talk to someone about how I'm feeling)' (social support).

### ***Driving Behaviour:***

If the participant indicated having passed their driving test and having driven in the last twelve months, they went on to complete the 23-item driving behaviour questionnaire.

Participants were asked to indicate on a five-point Likert scale (1= never; 5 = very often; minimum score = 4, maximum score = 20) questions relating to their driving behaviour such as 'How often do you miss warning signs?' as well as questions relating to their exposure to driving hazards such as 'How often do you have to drive in bad weather conditions?' and driving skill, such as 'How do you rate your driving skills?' (1= not very good; 5= very good; minimum score = 10, maximum score = 50). For information such as annual mileage, participants were asked to enter their annual mileage in a text box.

### **Design**

This cross-sectional study was presented as an online survey, delivered via the survey platform Qualtrics. All questions were counterbalanced (achieved by randomisation within the software) to alleviate any potential order effects. The presence of established predictors of well-being was assessed using multiple regression analyses, while the addition of driving behaviour to the model was examined using hierarchical multiple regression. Other data (e.g. annual mileage) and their potential association with driving hazards, driving skill and driving behaviour were explored using Pearson product-moment correlation coefficients.

### **Procedure**

A detailed information sheet outlining the aims and procedure of the study for participants to give informed consent to take part was provided at study sign up. Participants received the following instructions for completion of the well-being measurement:

'The following questions contain a number of single-item measures of aspects of your life as a student and feelings about yourself. Many of these questions will contain examples of what thoughts/behaviours the question is referring to which are important for understanding the focus of the question but should be regarded as guidance rather than strict criteria. Please try to be as accurate as possible but avoid thinking too much about your answers- your first instinct is usually the best'

With regard to student life, they were presented with the following instructions:

'Please consider the following elements of student life and indicate overall to what extent they have been a part of your life over the past six months. Remember to use the examples as guidance rather than trying to consider each of them specifically'.

Participants who had driven in the last twelve months completed the driving behaviour measure, with the following instructions:

'The following questions relate to your driving behaviour. Please answer as accurately as possible'.

At the end of the survey the participants were thanked for their time, shown a debrief statement and awarded course credits for their participation.

## RESULTS

### Established Well-being Predictors and Outcomes

Multiple linear regression analyses were computed for each of the predictors (stressors, positive personality, negative coping, conscientiousness and social support) with outcomes as the dependent variable (positive outcomes, negative outcomes, negative appraisal, positive appraisal and cognitive problems).

Negative well-being was predicted by high stressors, conscientiousness and negative coping scores and low positive personality and social support scores. The multiple regression revealed that these established predictors contributed significantly to the regression model,  $F(5, 210) = 73.05, p = .001$ , accounting for 63.2% of the variance in negative well-being.

Positive well-being was predicted by low stressors, high positive personality and social support, and low conscientiousness scores, and also contributed significantly to the regression model,  $F(5, 210) = 64.99, p = .001$ , accounting for 60.4% of the variance in positive well-being. Negative appraisals (e.g. perceived stress) were predicted by high negative coping, stressors and conscientiousness and low positive personality and social support scores. Overall, all five predictors produced a significant regression model,  $F(5, 209) = 84.29, p = .001$ , with the predictors accounting for 66.6% of the variance in negative appraisals and outcomes. Positive appraisals (e.g. life satisfaction) were predicted by low stressor and high positive personality and social support scores, with all predictors yielding a significant regression model,  $F(5, 210) = 72.26, p = .001$ , accounting for 62.9% of the variance in positive appraisals. Finally, cognitive problems were predicted by high stressor and negative coping scores and low positive personality and conscientiousness scores, with all predictors giving a significant regression model,  $F(5, 213) = 19.17, p = .001$ , accounting for 29.9% of the variance in cognitive problems. These results follow the pattern of the established well-being predictors and outcomes and afford confidence in the novel analyses to follow.

### Well-being outcomes and Driving

Analyses compared the well-being outcome scores of drivers and non-drivers. No significant differences were found.

### Factor Analyses of Driving Behaviour, Driving Hazards and Self-Reported Driving Skill

Factor analysis (with a varimax rotation) of the driving questions showed that these variables loaded on three separate factors (see Table 1). The factor scores were used in the analyses of well-being outcomes in all instances except that of driving hazards, driving behaviour and annual mileage, which utilises total scores for ease of interpretation.

Before conducting a hierarchical multiple regression (HMR), the relevant assumptions of this statistical analysis were tested. First, a sample size of 131 was deemed adequate given the six independent variables (IVs) in the analysis (Tabachnick & Fidell, 2013) [18]. The dependent variable was normally distributed. Collinearity statistics (Tolerance and VIF) were all within accepted limits, meeting the assumption of multicollinearity (Turkson & Otchey, 2015) [19]. Finally, residual and scatter plots indicated assumptions of normality, linearity and homoscedasticity were satisfied (Pallant, 2010) [20].

A two-stage HMR was conducted with each of the well-being outcomes as the dependent variable. The established predictor variables were entered at stage one of the regression to control for the established effects on the outcome. Driving behaviour was entered at stage two. The regression statistics can be found in Table 2.

**Table 1. Factor Analysis of Driving Behaviour, Driving Hazards and Self-Reported Driving Skill**

	DB factor: Eigenvalue = 1.45 % variance = 24.14	DH factor: Eigenvalue = 4.47 % variance = 40.67	DS factor: Eigenvalue = 1.76 % variance = 29.27
Use mobile when driving	.646		
Lapses of concentration	.525		
Hostility to others	.574		
Miss warning signs	.548		
Self-rate driving skill			.911
Others rate driving skill			.822
Drive in heavy traffic		.681	
Drive on motorway		.640	
Drive when tired		.694	
Drive with a cold		.642	
Drive late at night		.681	
Drive long periods		.726	
Drive after prolonged work		.665	
Listen to radio when driving		.611	
Conversations with passengers		.522	
Drive in bad weather		.716	

*Note.* DB = driving behaviour, DH = driving hazards, DS = driving skill; loadings <.04 not shown.

## Predicting Well-being Outcomes and Driving Behaviour

**Table 2. HMRs Showing Predictors for the Five Outcomes. (a) Positive outcomes (b) Negative outcomes (c) Negative appraisal (d) Positive appraisal (e) Cognitive problems**  
(a)

Predictors	Unstandardized Coefficients		Standardized Coefficients	t
	B	SE b	B	
<b>Step 1 Stressors</b>				
Positive personality	1.73	.184	.648	9.39***
Negative coping	.293	.178	.099	1.64
Social support	.605	.144	.265	4.19***
Conscientiousness	-.974	.453	-.2.15	-2.15*
<b>Step 2 Stressors</b>				
Positive personality	1.73	.184	.649	9.39***
Negative coping	.282	.179	.095	1.58
Social support	.608	.145	.267	4.20***
Conscientiousness	-.984	.454	-.142	-2.17*
Driving Behaviour	.616	.733	.048	.841*

Note. Adjusted  $R^2 = .55$  for Step 1; adjusted  $R^2$  for Step 2 = .57;  $\Delta R^2 = .02$ . \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

(b)

Predictors	Unstandardized Coefficients		Standardized Coefficients	t
	b	SE b	B	
<b>Step 1 Stressors</b>				
Positive personality	-1.30	.164	-.538	-7.89
Negative coping	.572	.157	.215	3.65***
Social support	-.456	.132	-.214	-3.47**
Conscientiousness	.145	.398	.233	3.64***
<b>Step 2 Stressors</b>				
Positive personality	-1.30	.161	-.539	-8.04
Negative coping	.596	.154	.224	3.87***
Social support	-.472	.129	-.222	-3.65***
Conscientiousness	1.45	.391	.233	3.71***
Driving Behaviour	1.52	.653	.127	2.32*

Note. Adjusted  $R^2 = .59$  for Step 1; adjusted  $R^2$  for Step 2 = .62;  $\Delta R^2 = .03$  \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

**(c)**

Predictors	Unstandardized Coefficients		Standardized Coefficients	
	b	SE b	$\beta$	t
<b>Step 1 Stressors</b>	.747	.129	.328	5.80***
Positive personality	-1.15	.195	-.513	-7.73***
Negative coping	.884	.186	.271	4.76***
Social support	-.408	.162	-.151	-2.51**
Conscientiousness	2.05	.473	.268	4.33***
<b>Step 2 Stressors</b>	.752	.127	.330	5.91***
Positive personality	-1.52	.192	-.154	7.77***
Negative coping	.910	.184	.279	4.95***
Social support	-.415	.160	-.154	-2.59**
Conscientiousness	2.04	.467	.268	4.38***
Driving Behaviour	1.61	.782	.110	2.06*

Note. Adjusted R2= .59 for Step 1; adjusted R2 for Step 2 = .63;  $\Delta R2 = .04$  \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

**(d)**

Predictors	Unstandardized Coefficients		Standardized Coefficients	
	B	SE b	B	t
<b>Step 1 Stressors</b>	-3.53	.126	-.160	-2.79*
Positive personality	1.91	.194	.652	9.81***
Negative coping	.297	.188	.091	1.58
Social support	.702	.152	.281	4.61***
Conscientiousness	-.924	.478	-.122	-1.93
<b>Step 2 Stressors</b>	-.350	.127	-.158	-2.76*
Positive personality	1.91	.194	.653	9.82***
Negative coping	.285	.188	.088	1.51
Social support	.706	.153	.282	4.63***
Conscientiousness	-.936	.478	-.123	-1.96
Driving Behaviour	.733	.773	.052	.949

Note. Adjusted R2= .57 for Step 1; adjusted R2 for Step 2 = .60;  $\Delta R2 = .03$  \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

(e)

Predictors	Unstandardized Coefficients		Standardized Coefficients	T
	B	SE b	B	
<b>Step 1 Stressors</b>	.105	.035	.233	2.30*
Positive personality	-.104	.054	-.174	-1.91
Negative coping	.152	.051	.233	2.96*
Social support	-0.16	.042	-.032	-.386
Conscientiousness	-.241	.132	-.158	-1.83
<b>Step 2 Stressors</b>	.106	.035	.235	3.04*
Positive personality	-.102	.054	-.171	-1.88
Negative coping	.147	.051	.225	2.87**
Social support	-.014	.042	-.028	-.339
Driving Behaviour	.329	.214	.114	1.53*

Note. Adjusted  $R^2 = .26$  for Step 1; adjusted  $R^2$  for Step 2 = .27;  $\Delta R^2 = .013$  \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

For positive well-being, the HMR revealed that at Step 1, the established predictors contributed significantly to the regression model,  $F(5, 130) = 36.46, p < .001$ . The addition of driving behaviour at Step 2 also yielded a significant regression model,  $F(6, 130) = 30.43, p < .001$ . Together, the three IVs accounted for 57% of the variance in positive well-being, indicating that when established predictors are held constant, driving behaviour also predicts positive well-being outcomes. For negative well-being, the established predictors contributed significantly to the model,  $F(5, 130) = 39.44, p < .001$ , and the addition of driving behaviour at Step 2 also returned a significant regression,  $F(6, 130) = 34.60, p < .001$ . The five IVs contributed to 62% of the variance in negative well-being, indicating that driving behaviour is predictive of negative outcomes.

For negative appraisals, the HMR yielded a significant contribution of the established predictors at Step 1,  $F(5, 130) = 44.24, p < .001$ , and at Step 2, the inclusion of driving behaviour also returned a significant regression model:  $F(6, 130) = 38.53, p < .001$ . Combined, the six IVs contributed to 63.4% of the variance in negative appraisals, demonstrating that driving behaviour predicts negative appraisal, in that the higher the driving behaviour score (more negative driving) the higher the negative appraisal score. For positive appraisals, there was a significant contribution to the model at Step 1,  $F(5, 130) = 41.43, p < .001$ , as well as at Step 2:  $F(6, 130) = 34.65, p < .001$ , indicating that lower driving behaviour scores are predictive of positive outcomes. Finally, for cognitive problems, there was a significant regression model at Step 1,  $F(5, 130) = 10.26, p < .001$ , as well as at Step 2,  $F(6, 130) = 9.06, p < .001$ , although driving behaviour did not contribute significantly to the model. Overall, the HMRs indicate that driving behaviour is associated with well-being.

### Well-Being and Driving Hazards

A Pearson product-moment correlation coefficient was computed to assess the relationship between well-being outcomes and driving hazards. No statistically significant relationship was found between the variables.

### 3.6. Well-Being and Driving Skill

To assess any relationship between well-being outcomes and driving skill, a further Pearson product-moment correlation coefficient was undertaken. There was a statistically significant positive relationship found for both positive outcome and positive appraisal. HMRs were conducted for positive appraisal and well-being to ascertain whether driving skill remained a predictor when the established well-being predictors were held constant. Results are summarised in Table 3.

For both positive outcome and appraisal, the HMR yielded a significant contribution of the established predictors at Step 1,  $F(5, 130) = 36.46, p < .001$ ;  $F(5, 130) = 41.43, p < .001$ , and at Step 2, the inclusion of driving skill also returned a significant regression model for both outcomes:  $F(6, 130) = 32.06, p < .001$ ;  $F(6, 130) = 36.17, p < .001$ . Combined, the five IVs contributed to 59% of the variance in positive outcomes, demonstrating that driving skill predicts positive well-being in that the higher the driving skill score (higher driving skill rating) the higher the positive well-being score. For positive appraisals, the five IVs together contributed to 62% of the variance in positive appraisal, again demonstrating that those who rate their driving skills highly also enjoy higher positive appraisal.

Table 3. HMRs Showing Predictors for (a) Positive outcomes and (b) Positive appraisal

Predictors	Unstandardized Coefficients		Standardized Coefficients	T
	b	SE b	$\beta$	
<b>Step 1</b> Stressors	-.324	.120	-.144	-2.44*
Positive personality	1.73	.184	.648	9.39***
Negative coping	.293	.178	.099	1.64
Social support	.605	.144	.265	4.19***
Conscientiousness	-.974	.453	-.141	-2.15*
<b>Step 2</b> Stressors	-.290	.119	-.144	-2.44*
Positive personality	1.75	.182	.656	9.62***
Negative coping	.285	.175	.096	1.62
Social support	.561	.144	.246	3.90***
Conscientiousness	-1.03	.447	-.149	2.31*
Driving Skill	1.68	.775	.125	2.17*

Note. Adjusted  $R^2 = .58$  for Step 1; adjusted  $R^2$  for Step 2 = .59;  $\Delta R^2 = .015$  \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

(b)

Predictors	Unstandardized Coefficients		Standardized Coefficients	
	B	SE b	B	t
<b>Step 1</b> Stressors	-.353	.126	-.160	-2.79*
Positive personality	1.91	.194	.652	9.81***
Negative coping	.297	.188	.091	1.58
Social support	.702	.152	.281	4.61***
Conscientiousness	-.924	.478	-.122	-1.93
<b>Step 2</b> Stressors	-.319	.126	-.144	-2.53*
Positive personality	1.92	.192	.658	10.03***
Negative coping	.289	.185	.089	1.56
Social support	.657	.152	.263	4.32***
Conscientiousness	-.984	.472	-.129	2.08*
Driving Skill	1.71	.819	.116	2.08*

Note. Adjusted  $R^2$  = .61 for Step 1; adjusted  $R^2$  for Step 2 = .62;  $\Delta R^2$  = .013 \* $p$  < .05, \*\* $p$  < .01, \*\*\* $p$  < .001.

### Driving Behaviour, Driving Hazards and Annual Mileage

Driving behaviour and annual mileage were compared to investigate whether there was any association between annual mileage, self-reported driving behaviour and exposure to driving hazards. Mean annual mileage was 7734.05 ( $SD$  = 3275.32), while mean driving behaviour and driving hazard scores were 10.60 ( $SD$  = 5.25) and 26.24 ( $SD$  = 12.24) respectively.

Pearson's  $r$  correlations revealed significant moderate positive correlations between annual mileage and higher levels of reported driving violations, explaining 42.3% of the variance ( $r$  = .65,  $n$  = 131,  $p$  < .001). A similar correlation was observed between annual mileage and exposure to driving hazards ( $r$  = .55,  $n$  = 131,  $p$  < .001; 30.3% of variance explained) suggesting an association between higher annual mileage, exposure to driving hazards and propensity to commit driving violations.

### DISCUSSION

The first analyses confirmed that the established well-being predictors in a student population were present in the current sample, affording more confidence in the addition of the more novel driving behaviour, hazard and skill variables. The second analyses demonstrated that more positive driving behaviour (engaging in fewer violations, such as indicating hostility to other drivers and missing warning signs) was associated with higher levels of positive well-being and appraisal, whereas those with higher levels of negative well-being and appraisal reported more violations. Also, drivers with higher levels of positive well-being and appraisal also reported higher levels of driving skill, with these findings being broadly in line with the recent work of Isler and Newland (2017) [11]. Unsurprisingly, increased annual mileage was associated with an increased risk of exposure to driving hazards, as well as increased levels of poor driving behaviour; although notably, this data was correlational, and thus cannot be taken as implying causality. That said, the identification of such an association lends itself to further

investigation. Driving itself was not found to be linked to well-being, although this is perhaps unremarkable given that the current sample did not drive as an occupation; such effects may be more applicable to professional drivers if well-being is known to be impacted by the work environment (e.g. King & Jex, 2014) [10]. In terms of RTC involvement, the present sample reported so few incidences (< 4 in the entire sample) that it was not possible to analyse this data in a statistically meaningful way in terms of its relation to the driving variables. It is suggested that the reasonably low reported annual mileages of the participants might provide a partial explanation, although an eyeball examination of the data revealed those who reported RTCs also scored highly in both negative well-being and reported more negative driving behaviour.

Behaviour associated with negative well-being, such as low positive personality, social support and coping scores starkly contrasts with adaptive, proactive and positive behaviour that has been linked with pro-social traits (Huppert, 2009) [20] and therefore, in a driving context, it is conceivable that drivers who score highly on negative well-being are less inclined to drive in adaptive or pro-social ways. Conversely, behaviours associated with positive well-being, predicted by positive affect (high optimism, self-efficacy and self-esteem) low stressors, negative coping and high social support scores have a strong relationship with pro-social behaviours, in that behaving in a pro-social manner *increases* positive well-being (Khanna, Sharma, Chauhan, Pragyendu, 2017) [21] and so it is possible that driving in a pro-social fashion aids positive well-being. Research supportive of this view undertaken by Taubman-Ben-Ari (2012) [22] revealed that when using priming procedures, positive affect translated into lower levels of willingness to drive in a recklessly in younger drivers. Positive appraisal, reflecting higher levels of life satisfaction (Schueller & Seligman, 2010) [23] has also been strongly linked to positive, proactive and adaptive behaviours, as well as optimal mental health, the latter being connected in the literature as consistent with better driving behaviour (Goudie, Mukherjee, de Neve, Oswald & Wu, 2014) [24]. Negative appraisal reflects fatigue and perceived stress which are both factors known to predict poor driving behaviour and RTCs (Smith, 2016) [5].

Clear associations between driving behaviour (the propensity to commit driving violations) and RTC involvement have been reported in other studies (e.g. Jafarpour & Rahimi-Movaghar, 2014) [25]. The current findings show that levels of well-being are associated with driving behaviour which could help to explain the underpinning motivation to drive in an anti-social fashion. This all points toward the necessity of an appreciation of driving in a more social context, as suggested by Parker et al. (1995) [7] and more recently by Isler and Newland (2017). [11] In this way, measurements of well-being may be used to predict future driving behaviours, as well as interventions developed for drivers which may increase levels of well-being and, by extension, increase driver safety.

While careful consideration was given to the methodology employed in this research, some limitations must be acknowledged, such as the sample being drawn from a Psychology student population, with older drivers and males being under-represented. As the survey was cross-sectional in design, confidence in causality is problematic. The study was based on self-report data which may have been biased to some extent with social desirability issues and respondent carelessness a possibility (discussed in detail by Bowling & Huang, 2018) [26] although encouragingly, Sullman and Taylor (2010) [27] found that self-reports of driver behaviour were largely unbiased. That said, the multi-variate approach undertaken in the present study, whereby known predictors of well-being were accounted for, and the novel predictors added to the regression model at step two, has addressed a previous gap in the literature, potentially heralding the beginnings of a more holistic approach to driver behaviour research.

The present study has identified links between well-being and driving behaviour and as such, provides an opportunity to consider ways in which drivers may be supported to achieve more positive safety behaviour while on the road. One way in which this may be realised is to use mindfulness, a term used to describe a particular way of paying attention to the present moment, characterised by a receptive and non-judgemental attitude (Kabat-Zinn, 1994) [28] which has garnered increasing research attention in recent years. In its broadest sense, mindfulness can be defined as the extent to which one attends to the present moment, rather than being preoccupied (Sauer et al., 2012) [29]. In this way, mindfulness may be understood as an attribute of consciousness empirically shown to promote positive well-being (Brown & Ryan, 2003) [30] which, considering the current findings, may prove a beneficial feature of driver training, such that well-being may mediate improved driving behaviour. Without a doubt, road safety is of key importance to individuals, businesses and society as a whole. Therefore, the identification of the underpinnings of poor driving behaviour and ways in which this may be improved ought to not be downplayed.

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## References:

1. Department for Transport. (2016). Reported road casualties in Great Britain: Main results 2015. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/533293/rrcgb-main-results-2015.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/533293/rrcgb-main-results-2015.pdf). Retrieved 2.5.18. GOV.UK. (2013). Accident and casualty costs. <https://www.gov.uk/gov-of-preventing-road-accidents>. Retrieved 3.5.18.
2. Crizzle, A.M., Bigelow, P., Adams, D., Gooderham, S., Myers, A.M., & Thiffault, P. (2017). Health and wellness of long-haul truck and bus drivers: A systematic literature review and directions for future research. *Journal of Transport & Health*, 6, 1-20. <http://dx.doi.org/10.1016/j.jth.2017.05.359>.
3. Reason, J.T., Manstead, A.S.R., Stradling, S.G., Baxter, J.S., & Campbell, K. (1990). Errors and violations on the road: a real distinction? *Ergonomics*, 36, 557-567. <http://dx.doi.org/10.1080/00140139508925170>.
4. Smith, A.P. (2016). A UK survey of driving behaviour, fatigue, risk-taking and road traffic accidents. *BMJ Open*. <http://dx.doi.org/10.1136/bmjopen-2016-011461>.
5. Bener, A., Yildirim, E., Özkan, T., & Lajunen, T. (2017). Driver sleepiness, fatigue, careless behavior and risk of motor vehicle crash and injury: Population based case and control study. *Journal of Traffic and Transportation Engineering*, 4, 496-502.
6. Parker, D., Reason, J.T., Manstead, S.R., & Stradling, S.G. (1995). Driving errors, driving violations and accident involvement. *Ergonomics*, 38 (5), 1036-1048. <https://dx.doi.org/10.1080/00140139508925170>.
7. Hu, T., Xie, & Li. (2013). Negative or positive? The effect of emotion and mood on risky driving. *Psychology and Behaviour*, 16, 29-40. <https://dx.doi.org/10.1016/j.trf.2012.08.009>.
8. de Cates, A., Stranges, S., Blake, A., & Weich, S. (2015). Mental well-being: An important outcome for mental health services? *The British Journal of Psychiatry*, 207 (3), 195-197. <https://dx.doi.org/10.1192/bjp.bp.114.158329>.
9. King, R., & Jex, S. (2014). *Age, Resilience, Well-Being, and Positive Work Outcomes. The Role of Demographics in Occupational Stress and Well Being*. Emerald Group Publishing Limited: London, 113 – 133.
10. Isler, R.B., & Newland, S.A. (2017). Life satisfaction, well-being and safe driving behaviour in undergraduate psychology students. *Transportation Research*, 47, 143-154. <http://dx.doi.org/10.1016/j.trf.2017.04.010>.
11. Cameron, J. E. (1999). Social identity and the pursuit of possible selves: Implications for the psychological well-being of university students. *Group Dynamics: Theory, Research, and Practice*, 3(3), 179-189. <http://dx.doi.org/10.1037/1089-2699.3.3.179>.
12. Lee, R.L., & Loke, A.J. (2005). Health promoting behaviors and psychosocial well-being of university students in Hong Kong. *Public Health Nursing*, 22, 209-220. <http://dx.doi.org/10.1111/j.0737-1209.2005.220304>.

13. Bayram, N., & Bilgel, N. (2008). The Prevalence and Socio-Demographic Correlations of Depression, Anxiety and Stress among a Group of University Students. *Social Psychiatry and Psychiatric Epidemiology*, 43, 667-672. <http://dx.doi.org/10.1007/s00127-008-0345>.
14. Williams, G. M., & Smith, A. P. (2012). A Holistic Approach to Stress and Well-Being. Part 6: The Wellbeing Process Questionnaire (WPQ Short Form). *Occupational Health (At Work)*, 9, 29-31.
15. Williams, G.M., Pendlebury, H., Thomas, K., & Smith, A.P. (2017). The student well-being process questionnaire (Student WPQ). *Psychology*, 8, 1748-1761. <https://dx.doi.org/10.4236/psych.2017.811115>
16. Tully, A. (2004). Stress, Sources of Stress and Ways of Coping among Psychiatric Nursing Students. *Journal of Psychiatric and Mental Health Nursing*, 11, 43-47. <https://dx.doi.org/10.1111/j.1365-2850.2004.00682>.
17. Tabachnick, B.G. & Fidell, L.S. (2013). *Using multivariate statistics, 6th Edition*. Boston: Pearson Education.
18. Turkson, A.J., & Otchey, J.E. (2015). Hierarchical multiple regression modelling on predictors of behavior and sexual practices at Takoradi Polytechnic, Ghana. *Global Journal of Health Science*, 7, 200-210. <https://dx.doi.org/10.5539/gjhs.v7n4p200>.
19. Huppert, F.A. (2009). Psychological well-being: evidence regarding its causes and consequences. *Applied Psychology: Health and Well-being*, 1, 137-164. <https://dx.doi.org/10.1111/j.1758-0854.2009.01008>.
20. Khanna, V., Sharma, E., Chauhan, S., Pragyendu. (2017). Effects of pro-social behaviour on happiness and well-being. *The International Journal of Indian Psychology*, 4, 77-86. <http://dx.doi.org/18.01.031/20170402>.
21. Taubman-Ben-Ari, O. (2012). The effects of positive emotion priming on self-reported driving. *Accident analysis and Prevention*, 45, 718-725. <http://dx.doi.org/10.1016/j.aap.2011.09.039>.
22. Schueller, S., & Seligman, M. (2010). Pursuit of pleasure, engagement and meaning: relationships to subjective and objective measures of well-being. *The Journal of Positive Psychology*, 5, 243-263. <http://dx/doi.org/10.1080/17439761003794130>.
23. Goudie, R.J.B., Mukherjee, S., de Neve, J.E., Oswald, A.J., & Wu, S. (2014). Happiness as a driver of risk-avoiding behaviour: theory and empirical study of seatbelt wearing and automobile accidents. *Economica*, 81, 674-697. <https://dx.doi.org/10.1111/ecca.12094>.
24. Jafarpour, S., & Rahimi-Movaghar, V. (2014). Determinants of risky driving behaviour: a narrative review. *Medical Journal of the Islamic Republic of Iran*, 28, 142.
25. Bowling, N.A., & Huang, J.L. (2018). Your attention please! Toward a better understanding of research participant carelessness. *Applied Psychology*, 67, 227-230. <http://dx.doi.org/10.1111/apps.12143>.
26. Sullman, M.J.M., & Taylor, J.E. (2010). Social desirability and self-reported driving behaviours: should we be worried? *Transportation Research*, 13, 215-221. <http://dx.doi.org/10.1016/j.trf.2010.04.004>.
27. Kabat-Zinn J. (1994). *Wherever you go there you are: Mindfulness meditation in everyday life*. New York: Hyperion.
28. Sauer S., Walach H., Schmidt S., Hinterberger T., Lynch S., Büssing A... et al. (2012). Assessment of mindfulness: review on state of the art. *Mindfulness* 4, 3-17.
29. Brown, K.W., & Ryan, R.M (2003). The benefits of being present: mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, 84, 822- 848. <http://dx.doi.org/10.1037/0022-3514.84.4.822>.

## APPENDIX

### Information

The following questions contain a number of single-item measures of aspects of your life as a student and feelings about yourself. Many of these questions will contain examples of what thoughts/behaviours the question is referring to which are important for understanding the focus of the question but should be regarded as guidance rather than strict criteria.

Please try to be as accurate as possible but avoid thinking too much about your answers- your first instinct is usually the best.

1. How stressful do you find your course on a scale of 1-10 (1 meaning "not at all stressful" and 10 meaning "the most stressful it could possibly be")?
2. How efficiently do you do your university work (1=not at all efficiently, 10 = extremely efficiently)?
3. I have been feeling good about my relationship with others (for example: Getting along well with friends driving skill/colleagues, feeling loved by those close to me)
4. I feel able to relax when I want to relax
5. I feel energetic and interested when I need to be
6. Thinking about myself and how I normally feel, in general, I mostly experience positive feelings (for example: I feel alert, inspired, determined, attentive)
7. When I find myself in stressful situations, I look for social support (for example: I talk to someone to get more information, I ask someone for advice, I talk to someone about how I'm feeling)
8. Please consider the following elements of student life and indicate overall to what extent they have been a part of your life over the past six months. Remember to use the examples as guidance rather than trying to consider each of them specifically:  
1= Not at all part of my life 10= Very much a part of my life
  1. Challenges to your development (e.g. important decisions about your education and future career, dissatisfaction with your written or mathematical ability, struggling to meet your own or others' academic standards).
  2. Time pressures (e.g. too many things to do at once, interruptions of your school work, a lot of responsibilities).
  3. Academic Dissatisfaction (e.g. disliking your studies, finding courses uninteresting, dissatisfaction with school).
  4. Romantic Problems (e.g. decisions about intimate relationships, conflicts with boyfriend/girlfriend skill' family, conflicts with boyfriend/girlfriend).
  5. Societal Annoyances (e.g. getting ripped off or cheated in the purchase of services, social conflicts over smoking, disliking fellow students).
  6. Social Mistreatment (e.g. social rejection, loneliness, being taken advantage of).
  7. Friendship problems (e.g. conflicts with friends, being let down or disappointed by friends, having your trust betrayed by friends).
9. Please state how much you agree or disagree with the following statements:  
1= Strongly disagree 2= Strongly agree
  1. There is a person or people in my life who would provide tangible support for me when I need it (e.g. money for tuition or books, use of their car, furniture for a new apartment).
  2. There is a person or people in my life who would provide me with a sense of belonging (for example: I could find someone to go to a movie with me, I often get invited to do things with other people, I regularly hang out with friends).
  3. There is a person or people in my life with whom I would feel perfectly comfortable discussing any problems I might have (for example: difficulties with my social life, getting along with my parents, sexual problems).

10. Overall, how stressful is your life?
11. On a scale of one to ten, how depressed would you say you are in general? (for example: Feeling 'down', no longer looking forward to things or enjoying things that you used to)
12. On a scale of one to ten, how happy would you say you are in general?
13. In general, I feel optimistic about the future (for example: I usually expect the best, I expect more good things to happen to me than bad, it's easy for me to relax)
14. I am confident in my ability to solve problems that I might face in life (for example: I can usually handle whatever comes my way, If I try hard enough I can overcome difficult problems, I can stick to my aims and accomplish my goals)
15. Overall, I feel that I have positive self-esteem (for example: On the whole I am satisfied with myself, I am able to do things as well as most other people, I feel that I am a person of worth)
16. When I find myself in stressful situations, I blame myself (for example: I criticise or lecture myself, I realise I brought the problem on myself)
17. When I find myself in stressful situations, I wish for things to improve (for example: I hope a miracle will happen, I wish I could change things about myself or circumstances, I daydream about a better situation)
18. When I find myself in stressful situations, I try to avoid the problem (e.g. I keep things to myself, I go on as if nothing has happened, I try to make myself feel better by eating/drinking/smoking)
19. I have been feeling in good spirits (for example: I feel optimistic about the future, feel good about myself and confident in my abilities)
20. I have been feeling good about my relationships with others (for example: Getting along well with friends/colleagues, feeling loved by those close to me)
21. I consider myself to be outgoing (for example: Talkative, comfortable with myself, confident in social situations)
22. When I find myself in stressful situations, I take a problem-focused approach (for example: I take one step at a time, I change things about my situation or myself to deal with the issue, I don't let my feelings interfere too much)
23. Overall, I feel that I am satisfied with my life (for example: In most ways my life is close to my ideal, so far, I have gotten the important things I want in life)
24. On a scale of one to ten, how anxious would you say you are in general? (for example: Feeling tense or 'wound up', unable to relax, feelings of worry or panic)
25. In general, I feel pessimistic about the future (for example: If something can go wrong for me it will, I hardly ever expect things to go my way, I rarely count on good things happening to me)
26. Overall, I feel that I have low self-esteem (for example: At times, I feel that I am no good at all, at times I feel useless, I am inclined to feel that I am a failure)
27. I feel that I have the social support I need (for example: There is someone who will listen to me when I need to talk, there is someone who will give me good advice, there is someone who shows me love and affection)
28. I prefer to keep to myself (for example: I don't talk much to other people, I feel withdrawn, I prefer not to draw attention to myself)
29. I feel that I have an agreeable nature (for example: I feel sympathy toward people in need, I like being kind to people, I'm co-operative)
30. I feel that I have a disagreeable nature (for example: I can be rude, harsh, unsympathetic)
  1. I feel that I am a conscientious person (for example: I am always prepared, I make plans and stick to them, I pay attention to details)
  2. I feel that I am laid-back about things (for example: I do just enough to get by, I tend to not complete what I've started, I find it difficult to get down to work)

3. I feel that I can get on well with others (for example: I'm usually relaxed around others, I tend not to get jealous, I accept people as they are)
4. I don't really get on well with people (for example: I tend to get jealous of others, I tend to get touchy, I often get moody)
5. I feel that I am open to new ideas (for example: I enjoy philosophical discussion, I like to be imaginative, I like to be creative)
6. I am not interested in new ideas (for example: I tend to avoid philosophical discussions, I don't like to be creative, I don't try to come up with new perspectives on things)
7. Thinking about myself and how I normally feel, in general, I mostly experience negative feelings (for example: I feel upset, hostile, ashamed, nervous)
8. In the last two weeks did you find that you have problems of memory (e.g. forgetting where you put things), attention (e.g., failures of concentration), or action (e.g. doing the wrong thing?)

1= Not at all 2= Rarely 3= Occasionally 4= Quite Frequently 5= Very Frequently

1. at work
2. Outside of work

9. How frequently in the last two weeks did you find that you were not getting as much work done as you would have liked?

1. at work
2. Outside of work

10. Have you driven a motor vehicle in the last 12 months (e.g. car, van etc.) Yes/No

The following questions relate to your driving behaviour. Please answer as accurately as possible. 1= Never 2= Rarely 3= Sometimes 4= Often 5= Very often

11. How often do you use your mobile phone when driving?
12. How often do you have lapses of concentration when driving?
13. How often do you indicate hostility to other drivers?
14. How often do you miss warning signs?
15. How often do you have to drive in bad weather conditions?
16. How often do you have conversations with passengers when you drive?
17. How often do you listen to the radio or other forms of in-car entertainment when you drive?
18. How often do you feel you are distracted when you drive?
19. How often do you have to drive after prolonged work?
20. How often do you have to drive for long periods?
21. How often do you have to drive late at night, in the early morning or the post-lunch period?
22. How often do you drive when you have a minor illness like a cold?
23. How often do you drive when you are tired?
24. How often do you drive on the motorway?
25. How often do you drive in heavy traffic?
26. How frequently do you drive?

1= Daily 2= Weekly 3= Monthly 4= Only when on vacation from university 5= Never

27. What is your annual mileage?
28. How do you rate your driving skills?
29. How do others rate your driving skills?

1= Not very good 2= Below average 3= Average 4= Above average 5= Very good