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Applicability of the Contextual Mediated Model to predicting road crashes in Ghana and the United Kingdom

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ABSTRACT

Models of driver crash risks have been developed in high income countries (e.g., the contextual mediated model). However, the extent to which these models apply to motoring in low and middle income countries, which bear the majority of the world's road crash fatalities is unknown. We investigate the applicability of a modified contextual mediated model which distinguishes between distal and proximal factors that increase crash liability. The model was applied to 404 UK and 478 Ghanaian motorists to examine the extent to which the processes underlying crash risk are culture specific. Path analyses showed that distal factors (e.g., anxiety, distracted driving susceptibility) predicted crash involvement directly and indirectly through errors, violations and hazard monitoring in both countries. Hazard monitoring was a significant predictor of crash involvement, independent of DBQ factors in both UK and Ghana*, highlighting its importance in understanding driver behaviour and crash risk. The findings provide empirical support for the usefulness of the revised contextual mediated model to explain driving behaviour in Ghana as well as the UK.*

Keywords: contextual mediated model, UK, Ghana, road crashes, crash risks

Highlights

- Models of driver crash risks have been developed in high income countries.
- The extent, to which these models apply to motoring in low and middle income countries, is unknown.
- The applicability of a model which distinguishes distal and proximal factors that increase crash liability was compared in the UK and Ghana.
- Distal factors (e.g., anxiety and distracted driving susceptibility) predicted crash involvement directly and indirectly through errors, violations and hazard monitoring in both countries.
- Hazard monitoring was a significant predictor of crash involvement, independent of DBQ factors.
- The findings point to intervention targets to reduce crash risks.

1. Introduction

Road traffic fatalities impose a large burden on human life with 1.35 million deaths globally every year (World Health Organisation, WHO, 2018). The worst affected countries are found in the Global South (Low and Middle-Income Countries [LMICs]), where 93% of the global deaths from road traffic injury occur (WHO, 2023). However, road traffic crashes also lead to substantial human and economic costs in higher income countries such as the UK. Across the globe there is evidence that driver-related behavioural factors contribute about 95% to crash causation (Petridou&Moustaki, 2000). Behavioural factors have not been given adequate attention in LMICs' research and policy, relative to their contribution to this public health challenge (Largarde, 2007). The case of Ghana exemplifies the contribution of road crashes to mortality and morbidity in Africa. The death rate from road crashes increased by 83.6% between 1991 and 2011 (Hesse &Offosu, 2014) and has grown 12-15% every year since 2008-2015 (NRSC, 2016).

In High Income Countries (HICs), behaviours identified to increase crash liability include risk taking, violations of traffic safety regulations and those that relate to human performance limitations; errors and lapses (de Winter &Dodou, 2010). Models of road traffic crash risks in HICs (e.g., the Contextual Mediated Model [Sumer, 2003], discussed below) may also be applicable to understand road traffic risk in LMICs. However, validation in new environments is required because of cultural variations in the driving context (Coleman, 2014; Mohan, 2002). Local driving environment and culture may influence the relationships between specific factors and driver crash risks (Nordfjaern et al., 2014). Little work has been done in this area (Staton et al., 2016).

1.2 The Contextual Mediated Model (Sumer, 2003)

The model explains the links between behavioural factors, crash risks and crash involvement based on research in HICs. The model distinguishes between distal factors and proximal factors in the prediction of crash involvement. The proximal factors are both stable (e.g., violations and errors) and transitory variables (e.g., drunk driving) that are closer to crash involvement and are modelled to directly increase the risk of crashes. The distal factors (e.g., safety attitudes, fatalistic beliefs and personality) are those that create the tendency to engage in risky driving behaviours that in turn predict crash involvement. In addition, distal factors may have direct effects on crash risk. Sumer (2003) found that personality factors, for instance, had an impact on road crashes through their effects on driving-related behaviour such as violations. Sumer (2003) found stronger relationships between distal factors than between proximal factors and crash involvement.

If the Contextual Mediated Model can be applied and modified to LMICs then it can inform policy-based prevention and training in order to reduce the heavy public health burden of road crashes in these areas. The applicability of the contextual model to LMICs requires further exploration; It is possible that there are psychological factors that are important to crash risk in LMICs such as Ghana which have been less frequently studied in the research literature that has focused on HICs. The LMIC context may also alter the level at which the antecedents of risky driving are present in comparison to HICs and there may be variations in the extent to which structures are in place to control dangerous practices.

1.3 Application of the Contextual Mediated Model to Ghana

In this paper we test the applicability of a revised version of the Contextual Mediated Model (see Figure 1) to the Ghanaian context. The model was revised (modified with additions) on the basis of findings from our prior qualitative study in Ghana (Dotse, Nicolson & Rowe, 2019) and other general literature on behavioural factors that predict road crashes. These modifications were necessary to account for cultural and contextual differences in driving behaviour and crash risk factors between High-Income Countries (HICs) and Low and Middle-Income Countries (LMICs).The revised model proposes a number of distal factors; personality (e.g., impulsivity), beliefs, attitudes (e.g., risk perception), stress related factors (e.g., fatigue) and socio-demographic factors that may predict crash involvement both directly and indirectly. The model further proposes hazard monitoring, violations and errors as proximal factors (behavioural crash risks) that may have direct links to crash involvement and may mediate the links between distal factors and crash involvement.

The present study aimed to model the processes underlying risky driving behaviours in Ghana and compare them to the processes underlying risky driving in the UK through the application of the revised Contextual Mediated Model (see Figure 1). Ghana has a high rate of road traffic fatalities, with an increasing trend over the past decades (WHO, 2023). In contrast, there is a lower rate of fatalities in the UK; the rate fell dramatically since 1980-2010, with little change since then (Department for Transport, 2023). These differences provide a valuable context for comparing the applicability of the revised Contextual Mediated Model in both countries. Samples of drivers from Ghana and UK completed a battery of questionnaires measuring the components of the model. The demographic and socio-economic contexts of the UK and Ghana differ significantly. In Ghana, there is a higher proportion of commercial drivers compared to the UK, where private vehicle ownership is more common. Additionally, the driving environments and regulatory

frameworks in these countries vary, with Ghana facing challenges such as less stringent enforcement of traffic laws and poorer road infrastructure.

Based on evidence from HICs (e.g., Constatinou et al., 2011) the Big Five personality dimensions were hypothesized to predict crash involvement indirectly through violations and errors while the link between impulsivity and crash involvement was predicted to be mediated by hazard monitoring, violations and errors. Existing findings indicate that fatalistic beliefs are often associated with risk-taking behaviours (Slovic et al., 1981; Teye-Kwadjo, 2019) rather than attentiveness to hazards. Therefore, in the present study fatalistic beliefs were expected to relate to crash involvement through only violations. Socio-demographic factors are modelled to relate to crash involvement both directly and indirectly through the mediators; hazard monitoring, violations and errors based on the literature (e.g., de Winter &Dodou, 2010; Evans 2000). Anxiety and risk perception were hypothesised to relate to crash involvement indirectly through all three mediators; hazard monitoring, violations and errors (Sumer, 2003). The driver stress factors (e.g., fatigue) and distraction were hypothesized to relate to crash involvement via violations, errors and hazard monitoring (Ge et al., 2014; Olson et al., 2009) while the link from safety maintenance practices to crash involvement was predicted to be mediated by errors. We hypothesized that safety maintenance practices would predict crash involvement via errors because proper maintenance of a vehicle is crucial for its safe operation. Poor maintenance can lead to mechanical failures, which may result in errors during driving. For instance, a poorly maintained braking system can cause a driver to misjudge stopping distances, leading to errors. Aside from the indirect effects the model also examined direct paths between the distal factors and crash involvement.

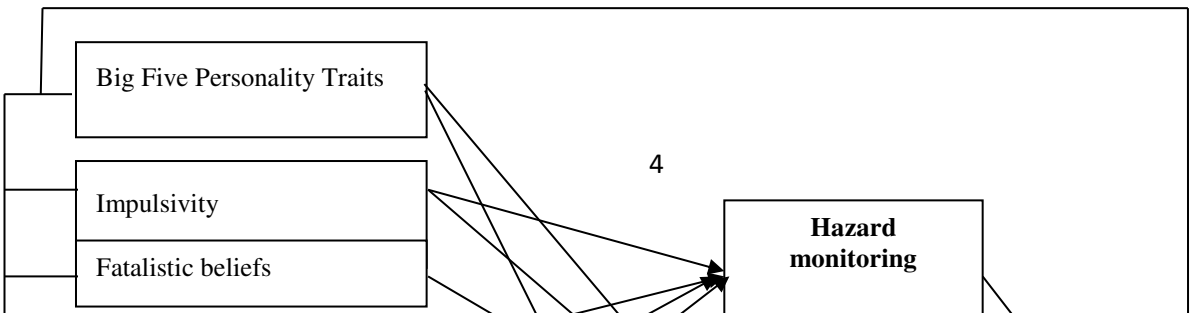


Fig1: Revised hypothesised contextual mediated model of the behavioural predictors of road crashes (adapted from Sumer, 2003)

In the Ghanaian sample two factors; errors and violations were measured using the Driver Behaviour Questionnaire (DBQ; Reason et al., 1990). The two factors (errors and violations) were expected in the DBQ for Ghana based on a previous Ghanaian factor analysis (Dotse& Rowe, 2021). Four DBQ factors (aggressive violations, ordinary violations, slips and errors) were measured in the UK sample. The four factors were expected in the UK based on the factor structure most commonly reported in HICs (e.g., Lajunen et al., 2004). Economic conditions in Ghana, where resources for vehicle maintenance is limited (Dotse et al., 2019), could lead to a higher incidence of driving errors and crashes. In contrast, the UK, with better economic conditions and stricter vehicle maintenance regulations, might exhibit different patterns of driving behaviour and crash risk.

2. Method

2.1 Sample and data collection

2.1.1 Ghana

A total of 478 Ghanaian drivers aged between 23 and 86 years (*Mean =39.5, SD =12.51*) responded to the survey. The driving experience of participants (4.81% of cases missing) ranged between <1- 46 years of driving (*Mean = 15.81, SD* = 11.04). The participants' daily hours of driving ranged between < 30 mins - 10+hrs *(Mean =3.36, SD = 1.82*) with 0.4% doing up to8 hrs+ of non-stop driving on long journeys *(Mean =2.97, SD = 1.39)*. Both the commercial (80%) and non commercial (20%) vehicle drivers were included in the sample. Data were collected from three regions (Greater Accra, Ashanti, and Volta) in Ghana. Commercial drivers were recruited and provided data at major lorry terminals located in the regional capitals; Accra, Kumasi, and Ho respectively. Private car and truck drivers were recruited through personal approaches in the premises of public and private organisations and mutual acquaintance. For the Ghanaian sample 2.1% held license class 'A' (mopeds; 50- 250cc+), 41.6% held class 'B' (cars < 3000kg), 27.2% held class 'C'(33 seater/trucks; 3000- 5500kg), 14.9% held class 'D' (vehicles ≤ 8000kg), 6.1% held class 'E' (tractors/ bulldozers), and 5% held class 'F' (vehicles > 8000kg).

2.1.2 UK

For the UK sample, 404 valid responses were obtained through an online questionnaire. Participants ranged in age from 18 to 75 years (Mean = 34.10, SD = 14.12) and included both licensed and unlicensed drivers. Their driving experience range from 6 months to 58 years (*Mean =14.39, SD =13. 24)*. The participants daily hours of driving ranged between < 30 mins - 10+hrs *(Mean = 2.25, SD = 1.0).* One percent drove up to 8hrs non-stop on long journeys *(Mean =3.78, SD = 0.74)*. The eligibility criterion was holding a full driving licence, however, 8 participants (1.9%) indicated that they did not hold valid driving licences (and therefore were driving illegally) but drove regularly. The UK participants with invalid licenses were retained to ensure comparability with the Ghanaian dataset, which included drivers with varying levels of compliance with licensing regulations. This approach aimed to capture a broader range of driving behaviours and experiences, providing a comprehensive understanding of driving behaviours and crash risks in both countries. Including these participants enables a more nuanced understanding of the impact of regulatory compliance on driving behaviour and crash risk. The questionnaire was distributed through the Qualtrics online platform (www.qualtrics.com) to ensure a diverse sample.

2.1.3 Ethics

Ethical approval for the study was obtained from the relevant institutional review boards in both Ghana (Ethics Committee for the Humanities - University of Ghana: ECH 109/15-16) and the UK (University of Sheffield Department of Psychology - Reference Number: 007634). Participants

were informed about the purpose of the study, and their consent was obtained before participation. Confidentiality and anonymity were assured, and participants were informed that they could withdraw from the study at any time without any consequences. Data were securely stored and only accessible to the research team. The study adhered to the ethical guidelines outlined by the American Psychological Association and the British Psychological Society.

2.2 Measures

2.2.1 Proximal factors

2.2.1.1 Driver Behaviour: We used a 27 item version of the DBQ (Lajunen et al., 2004) that included additional 'drink and drive' item taken from Mattsson (2012) for both the Ghanaian and the UK samples. Typical results from testing the factorial structure of DBQ in HICs distinguish ordinary violations (8 items, e.g., overtake a slow driver on the inside), aggressive violations (3 items, e.g., sound your horn to indicate your annoyance to another road user), errors (8 items, e.g., failed to check rear-view mirror before pulling out or changing lanes, etc.) and lapses (8 items, e.g., get into the wrong lane approaching roundabout or a junction) (Lajunen et al., 2004). This version of the DBQ has been subjected to robust factorial invariance testing by a number of researchers (e.g., Mattsson, 2012;Stanojević, Lajunen, Jovanović, Sârbescu, &Kostadinov, 2018). The drink and drive item has been found to load onto the ordinary violation component (Mattsson, 2012). Respondents indicate how often they engage in each of the behaviours on a six-point Likert scale (never = 0, hardly ever = 1, occasionally = 2, quite often = 3, frequently = 4, nearly all the time = 5). The DBQ factors had Cronbach alphas ranging from .73 to .87 in both samples, indicating acceptable reliability. Crash involvement (crash resulting in injury, death or damage to property and which involve at least one vehicle) 'while you were driving' was measured through self-report as in previous studies (Iversen &Rudmo, 2004; Ulleberg&Rudmo, 2003).

*2.2.1.2 Hazard monitoring***:** This construct was measured using a 2-item self-report sub-scale of the Driver Stress Inventory ([DSI] Matthews et al., 1997). It is the revised form of the alertness sub-scale of the Driver Behaviour Inventory ([DBI] Glendon et al., 1993) that assesses stress vulnerability among drivers. An example item was, *I make an effort to see what's happening on the road a long way in front of me*. Participants indicated how strongly they agreed with each of the statements that relate to their everyday driving on a scale of 0 (not at all) to 10 (very much). A higher score on the sub-scale represented more attentive hazard monitoring. The hazard monitoring scale had Cronbach alpha of .78 in the Ghanaian sample and .81 in the UK sample. Subjective measures of hazard perception have been found to correlate with objectively measured

hazard perception performance (Abele et al., 2018). Hazard perception skill has been found to be associated with crash risk (Horswill, Hill & Jackson, 2020).

2.2.2 Distal factors

2.2.2.1 Driver stress: The remaining four components of the DSI (Matthews et al., 1997) were used to measure driver stress, each with 2 items per scale. The dimensions were; *Aggression* (e.g., I really dislike other drivers who cause me problems), *Dislike of driving* (e.g., I feel tense or nervous when overtaking another vehicle), *Fatigue* (e.g., I become sleepy when I have to drive for several hours), *Thrill-seeking* (e.g., I like to raise my adrenaline levels while driving). The observed alpha coefficients for the subscales ranged from .73 - .87 in a British sample and from .69 - .85 in a US sample(Matthews et al., 1997). Higher scores on the sub-scales represent higher stress. Driver stress, mental health and daily hassles have been found to correlate with DBQ measures in previous research (e.g., Delhomme, & Gheorghiu, 2021). The driver stress negative affect factor was related to both lapses and errors, whereas driver stress risk taking was the strongest correlate of violations (Rowden et al., 2011).

2.2.2.2 Anxiety: The short form of the trait dimension of the State-Trait Anxiety Inventory (STAI-T-6) (Marteau &Bekker, 1992) was completed. Examples items are, *I worry too much over something that really doesn't matter*and *I feel secure (reverse coded).* For each item, participants indicated '*how they generally feel*' by checking one of the following alternatives: (1) *Almost never,* (2) *Sometimes,* (3) *Often,* (4) *Almost always.* A Cronbach alpha of .73 was observed for the Trait Anxiety factor (Marteau & Bekker, 1992). Dula et al. (2010) found higher levels of anxiety to be associated with greater levels of dangerous driving. Similarly, trait anxiety was found to predict poor driver behaviour (Wong et al., 2015)

2.2.2.3 Impulsivity: We used the short form of the Barratt Impulsiveness Scale (BIS-15; Spinella, 2007) which measures impulsivity-related behaviours in the general population. It measures 3 facets of impulsivity; non-planning (e.g., I plan tasks carefully; *reverse coded*), motor impulsivity (e.g., I do things without thinking) and attention impulsivity (e.g., easily bored solving thought problems). Items are rated on a 4-point Likert scale (1 = rarely/never, 2 = sometimes, 3 = often and 4 = almost always). A higher score indicates greater impulsivity. The scale is treated as unidimensional (α = .83; Meule et al., 2015) in the present study.

2.2.2.4 Personality: The 10 item abbreviated version of the Big Five Inventory (BFI) (Rammstedt& John, 2007) was used. The scale has been validated with English and German samples. The BFI consists of 10 short-phrase items, rated on a five-step scale; 1 = strongly disagree, 2 = disagree a little, 3 neither disagree nor agree, 4 = agree a little and to 5 = strongly agree. The items were selected using both consensual expert judgment and empirical item analyses to represent the core (i.e., most prototypical) traits that define each personality domain (John, 1990). Two BFI items address each Big Five dimension with acceptable psychometric properties; Mean retest stability coefficients were .72 – .80 in US, .78- .80 in Germany, and .75 overall, demonstrating that the BFI-10 scales achieved acceptable stability over 6-8 weeks in both cultures. The items cover the dimensions of extraversion, agreeableness, conscientiousness, neuroticism and openness.

2.2.2.5 Fatalistic beliefs: The index for belief in fate measure (Kouabenan, 1998) consists of nine items which describe situations referring to popular beliefs expressing a certain level of fatalism or superstition and to which participants express their agreement on a scale of 1-4 (strongly agree, agree, disagree, and strongly disagree). The items cover issues of fate, evil spirits mystery, conspiracy, hearse seeing (seeing a hearse signifies impending disaster), transgressions, black cat (signifies a bad omen), mascots (a person, animal, or object that is thought to bring luck), and consultation of clairvoyants. The measure was devised for professional drivers and validated in a Francophone African culture; Cote d'Ivoire ($\alpha = .78$; [Kouabenan, 1998]).

2.2.2.6 Risk Perception: Risk perception was measured with two items used by Uleberg and Rudmo (2003). First, the respondents rated their subjective evaluation of the probability of them (relative to an average driver) being involved in a future crash, ranging from 1 (not probable at all) to 7 (very probable). Second, they express how worried and concerned they are regarding being hurt in a crash, ranging from 1 (not worried at all) to 7 (very worried). Higher scores represent higher crash risk perception.

2.2.2.7 Distraction: The Susceptibility to Driver Distraction Questionnaire (SDDQ) (Feng, Marulanda, &Donmez, 2014) was completed. Self-reported frequency of distraction engagement in the course of driving was assessed by pairing the question stem 'When driving, you...' with six driver distractions: (1) have phone conversations, (2) manually interact with a phone (e.g., sending text messages), (3) adjust the settings of in-vehicle technology (e.g., radio channel or GPS), (4) read roadside advertisements, (5) visually dwell on roadside accident scenes if there are any, and

(6) chat with passengers if there are any. Responses were made on a Likert scale scored from 1 (never) to 5 (very often).

2.2.2.8 Safety maintenance: Two items that measure vehicle mechanical maintenance practices related to safety were used (Newman, Watson & Murray, 2002). The questions ask how likely a driver is to do the following before driving; (1) check the water in the radiator and (2) check the pressure in the tyres. Responses are anchored on a 5 point Likert scale; very unlikely (1) to very likely (5). The scale was validated among 204 Australian fleet drivers and was internally consistent with Cronbach's alpha of .81 for a work vehicle, and .79 for a personal car (Newman et al., 2002).

2.2.2.9 Socio-demographic factors

Other information that was collected included; the number of years in driving (experience), average weekly driving mileage, sex, age, and level of formal education.

2.3 Data Analysis Strategy

The primary analyses involved mediation analyses of the relationship between distal factors and crash involvement via proximal factors. To achieve this we adopted Anderson and Gerbing's (1988) two-step model estimation process. In the first step a measurement model was constructed to examine the factor structure and correlations between the latent constructs via Confirmatory Factor Analysis (CFA). The measurement model related each construct to their latent indicators. Next, the measurement model was extended to a Structural Equation Model (SEM) with the addition of the hypothesized relationships mediating relationships between proximal and distal variables in predicting the crash involvement outcome.

CFA was first used to confirm the factor structure of the DBQ in the Ghana and UK samples. In the Ghanaian sample, the initial model specified a 2-factor model identified as most appropriate in a previous Ghanaian sample (Dotse and Rowe, 2019). The CFA on the UK data specified the 4-factor DBQ structure typically reported in HICs (e.g., Lajunen et al., 2004). The drink-drive item was as modelled as part of ordinary violations based on its performance in previous cross-cultural studies in the UK (Mattsson, 2012).

The model parameters were estimated using Robust Maximum Likelihood Estimation (MLR; Muthen & Muthen, 2012). MLR utilises the Satorra-Bentler $\chi 2$ statistic (1988) which corrects the

scaling of the χ2 statistic (and thus of CFI, TLI and RMSEA) when assumptions of multivariate normality are not met. Standard errors are computed (for model parameter estimates) that are similarly robust to deviations from multivariate normality (Byrne, 2013). The adequacy of models was assessed using three fit indices; Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI). Values of RMSEA ≤ .08, CFI and TLI ≥ .90 indicate adequate model fit (Hu &Bentler, 1999) while RMSEA ≤ .06, with CFI and TLI ≥ .95 indicate excellent model fit (Bentler, 1990). Only the fully standardised estimates were reported in the study. All models were estimated in Mplus v.7.11 (Muthen&Muthen, 2012).

Models of direct and indirect effects were examined in which distal factors were modelled as predictors of crash involvement via errors, violations and hazard monitoring (our proximal risk factors for crash involvement [see Figure1]). To test the meditational paths, 95% confidence intervals (95% Bias-Corrected Bootstrapped Confidence Intervals [BCa CI's]) were computed from 10000 bootstrap samples (MacKinnon, Lockwood, & Williams, 2004). Next, the CFA model was extended with a series of structural models; the hypothesized model (M2; all mediators entered at the same time) that included the direct and indirect paths (partial mediation; see Fig 1for the hypothesized model) and (M3) the full mediation (direct paths removed) were tested. To test the predictive effect of covariates; sex, age, mileage and experience (years in driving) were added to the models. Inclusion of these variables in the models ensures that spurious relationships between factors were not identified as a result that both are related to age, sex, mileage and experience. Covariate results are not discussed.

3 Results

3.1Demographic Factors

The Ghanaian sample consisted predominantly of commercial drivers (80%), whereas the UK sample included a mix of private and commercial drivers. The average age of drivers in Ghana was higher (Mean = 39.5 years) compared to the UK (Mean = 34.1 years; t (880) =7.99, $p < 0.05$). Additionally, the gender distribution differed, with a higher proportion of male drivers in Ghana (85%) compared to the UK (60%). These differences in sample characteristics are crucial for understanding the context of the findings.

3.2 Factor structure of the DBQ (Ghana and UK)

In the Ghana data, the CFA indicate that the two factor DBQ model (violations and errors) based on 24 items has a better fit for the data (χ^2= 831.98 (118), p<.001, RMSEA = .09,CFI = .96; TLI

= .96) than a 1-factor model (χ^2= 853.57 (151), p<.001, RMSEA = .10,CFI = .93; TLI = .92). A 3-factor model (violations, errors and lapses) has a poorer fit (χ^2= 1110.42 (169), p<.001; RMSEA = .11,CFI = .87; TLI = .86) than the 1-factor model while the 4-factor model (ordinary violations, aggressive violations, errors and lapses) had the worst fit (χ^2= 1933.75 (177), p<.001; RMSEA = .17,CFI = .89; TLI = .89). An excellent fit was obtained for the present 2-factor structure as indexed by the CFI and TLI and the .09 RMSEA fit was acceptable (Hu &Bentler, 1999).

Two competing models; 3-factor and 4-factor were specified for the UK data based on existing findings (e.g., Lajunen et al., 2004; Reason et al., 1990). The 3-factor model (violations, errors and lapses) gave a good fit (χ^2= 1068.44 (321) p<.001, RMSEA = .08,CFI = .97; TLI = .97) but the 4-factor model (ordinary violations, aggressive violations, errors and lapses) fit better (χ^2= 979.08 (318), p<.001; RMSEA = .07,CFI = .97; TLI = .96). In comparison, a 2-factor model (violations and errors) had a poor fit (χ^2= 1149.89 (290), p<.001, RMSEA = .10, CFI = .63; TLI = .60).

3.3 Measurement model CFA (Ghana and UK)

For the Ghanaian data, the measurement model, M1, consists of 18 latent constructs (15 distal and 3 proximal constructs) while the UK had 20 latent constructs (15 distal and 5 proximal), as there were 4 DBQ factors in the UK and 2 in Ghana. The Ghanaian measurement model (see Table 1, M1a in the Appendices) showed adequate fit with all items having significant (all p<.001) and strong loadings (.58 – .92) on their respective latent variables. No theoretically sound modification indices were suggested that could have improved model fit via the MPlus modification indices routine. Similarly, the full measurement model (M1) for the UK data (see Table 2, M1b in the Appendices) showed satisfactory fit to the data with all items having significant (all p<.001) and strong loadings (.50 – .89) on their respective latent variables.

3.4 Testing the structural model

The measurement models indicated that the latent variables required to test the proposed mediating pathways from distal factors to crash involvement were effectively estimated from the observed variables in both the Ghana and UK datasets. Self-reported number of crashes within the last 12 months was the outcome variable and demographic variables; age, sex, mileage and experience included as distal factors to predict proximal factors and crash involvement. The goodness of fit indices of several nested models were compared prior to selecting the final models in the two data sets. The partial mediation model (direct and indirect paths; See Tables 1-2 in Appendices) with all mediator variables included (M2) provided a better fit to the data than the full mediation model

405 which only contained indirect paths (M3) in both the UK and Ghana datasets. A chi-square
406 difference test revealed that M3 had significantly worse fit than M2 in both the Ghanaian (χ^2 (1)
407 = 23.81, p<.001) and UK (χ2 (1) = 21.69, p<.001) samples.
408
409 *3.4.1 Ghanaian mediation results*
410 Tables 3a-3c show the direct and indirect pathways included in Model M2. This includes
411 prediction of crashes directly from the distal factors and indirectly via the proximal factors. Figure
412 2 presents the path diagram. All three proximal pathways to crashes; from hazard monitoring (B
413 = -.21, p<.05), violations (B = .29, p<.05) and errors (B = .17, p< .05) were significant. The
414 direction of the effects was that lower levels of hazard monitoring and higher frequencies of
415 violations and errors were associated with higher crash involvement.
416

Table 4.5a Models (direct and indirect) of the effects of distal factors on crashes via proximal/behavioural factors (hazard, violations, errors and lapses) for Ghana and UK

	Hazard Monit.	Violations	Errors	Hazard	Ord. Viol	Aggress Viol.	Errors	Lapses
	GH	GH	GH	UK	UK	UK	UK	UK
Anxiety								
Direct effect	-.11*	**.47*** **	**.13***	-.10	.08	.22**	**.09***	.18*
Indirect effect (95% CI)	-.01 (-.02, .01)	**.04** (.01, .05)**	**.07** (.02, .11)**	.00 (-.00, .00)	.00 (-.02, .02)	.01 (-.00, .01)	**.12** (.04, .47)**	.00 (-.01, .02)
Total effect	-.11	**.51*** **	**.20****	-.10	.08	.23**	**.21****	.18
Impulsivity								
Direct effect	-.42***	.06	.11*	-.33***	.13	.02	**.56****	.37**
Indirect effect	.03** (.01, .04)	.00 (-.01, .01)	.01 (-.01, .02)	.00 (-.01, .00)	.00 (-.01, .01)	.00 (-.00, .00)	**.10* (.01, .12)**	.00 (-.01, .00)
Total effect	-.39***	.06	.12	-.33***	.01	.02	**.66*** **	.37
Extraversion	na							
Direct effect	na	.04	.02	-.13**	.15*	.09	.18**	.09
Indirect effect	na	.00 (-.01, .01)	.00 (-.01, .01)	.00 (-.00, .01)	.00 (-.01, .01)	.00 (-.01, .02)	.01 (-.00, .02)	.00 (-.01, .00)
Total effect	na	.04	.02	-.13**	.15*	.09	.07	.09
Agreeableness								
Direct effect	na	-.07*	-.16**	na	-.14*	-.12	-.18**	na
Indirect effect	na	-.00 (-.01, .01)	.00 (-.01, .02)	na	-.00 (-.01, .01)	-.01 (-.02, .01)	-.02 (-.06, .01)	na
Total effect	na	-.07	-.16**	na	-.14	-.13	-.20**	na
Conscientiousness								
Direct effect	na	na	-.39***	na	na	na	na	na
Indirect effect	na	na	-.01 (-.05, .03)	na	na	na	na	na
Total effect	na	na	-.40***	na	na	na	na	na
Neuroticism								
Direct effect	-.11*	.12*	.14*	**-.26*** **	.02	.19**	.19**	na
Indirect effect	.01 (-.01, .02)	.00 (-.01, .02)	.00 (-.01, .00)	**.14** (.09, .43)**	.00 (-.01, .02)	.01(-.03, .01)	.08 (-.02, .00)	na
Total effect	-.10*	.12*	.14*	**-.12****	.02	.20**	.27**	na
Openness								
Direct effect	na	-.01	-.09*	.19**	-.01	-.05	na	na
Indirect effect	na	-.00 (-.01, .02)	-.00 (-.01, .01)	-.01 (-.01, .01)	-.00 (-.00, .01)	-.00 (-.02, .01)	na	na
Total effect	na	-.01	-.09*	-.20**	-.01	-.05	na	na

** p<.05, ** p<.01, ** *p<.001*
95% CI (confidence interval, based on 10,000 bias-corrected bootstrapped samples)
N (GH = 478, UK = 404)
NA = Not Applicable
Significant mediation effects are in bold phases

Table 4.5b Models (direct and indirect) of the effects of distal factors on crashes via crash risks (hazard, violations, errors and lapses) for Ghana and UK

	Hazard monit.	Violations	Errors	Hazard	Ord. Viol	Aggress Viol.	Errors	Lapses
	GH	GH	GH	UK	UK	UK	UK	UK
Fatalistic Beliefs								
Direct effect	na	**.11****	**.22*****	na	-.07	.01	na	na
Indirect effect (95% CI)	na	**.04** (.01, .03)**	**.07* (.01, .04).**	na	-.02 (-.00, .00)	.00 (-.00, .01)	na	na
Total effect	na	**.15***	**.29*****	na	-.09	.01	na	na
Risk perception								
Direct effect	**.15****	**-.10****	-.02	.10*	-.02	-.14*	-.03	-.03
Indirect effect	**-.05* (-.02, -.01)**	**-.09** (-.02, -.22)**	-.00 (-.01, .01)	-.00 (-.01, .00)	-.00 (-.01, .01)	-.00 (-.00, .01)	-.00 (-.00, .00)	-.00 (-.00, .00)
Total effect	**.10***	**-.19****	-.02	.10	-.02	-.14	-.03	-.03
Aggression								
Direct effect	na	**. 20****	.03	na	.14*	.02	.06	.01
Indirect effect	na	**.11** (.03, .32)**	.00 (-.01, .01)	na	.01 (-.00, .00)	.00 (-.01, .01)	.00 (-.01, .00)	.00 (-.00, .00)
Total effect	na	**.31****	.03	na	.15*	.02	.06	.01
Dislike for driving								
Direct effect	na	.10*	.14*	-.17**	.01	.06	.08	.13*
Indirect effect	na	.00 (-.01, .01)	.00 (-.01, .01)	.00 (-.00, .01)	.00 (-.01, .01)	.00 (-.01, .01)	.00 (-.00, .00)	.00 (-.00, .00)
Total effect	na	.10	.14*	-.17**	.01	.06	.08	.13*
Fatigue								
Direct effect	na	**.19*****	**.16***	na	.27***	.18**	.13*	.07
Indirect effect	na	**.16** (.02, .04)**	**.08* (.01, .04)**	na	.00 (-.01, .01)	.00 (-.01, .02)	.00 (-.01, .00)	.00 (-.00, .00)
Total effect	na	**.35*****	**.24****	na	.27***	.18**	.13*	.07
Thrill seeking								
Direct effect	na	.06	.17**	**-.49*****	.22**	.09	.03	.10
Indirect effect	na	.00 (-.01, .01)	.11** (.01, .03)	**.04* (.01, .02)**	.01 (-.01, .01)	.01 (-.00, .01)	.00 (-.00, .00)	.00 (-.00, .00)
Total effect	na	.06	.28***	**-.45*****	.23	.10	.03	.10
Distraction								
Direct effect	**-.19***	.10*	**.21****	**-.12***	.28***	.03	**.12****	.18*
Indirect effect	**-.11* (-.02, -.08)**	.00 (-.01, .01)	**.09* (.01, .05)**	**-.10* (-.02, -.03)**	.00 (-.01, .01)	.00 (-.01, .01)	**.11* (-.00, .01)**	.03 (-.01, .00)
Total effect	**-.30*****	.10*	**.30*****	**-.22****	.28***	.03	**.23****	.21**

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

95% CI (confidence interval, based on 10,000 bias-corrected bootstrapped samples)

N (GH = 478, UK = 404)

NA = Not Applicable

Significant mediation effects are in bold phases

Table 4.5c Models (direct and indirect) of the effects of distal factors on crashes via crash risks (hazard, violations, errors and lapses) for Ghana and UK

	Hazard monit.	Violations	Errors	Hazard	Ord. Viol	Aggress Viol.	Errors	Lapses
	GH	**GH**	**GH**	**UK**	**UK**	**UK**	**UK**	**UK**
Maintenance								
Direct effect	.10*	**.22*** **	**.13** **	na	-.10	-.22**	na	na
Indirect effect (95% CI)	.01(-.02, .02)	**.06* (.02, .04)**	**.04* (-.02, -.01)**	na	-.00 (-.00, .00)	-.00 (-.01, .02)	na	na
Total effect	.09*	**.28*** **	**.17***	na	-.10	-.22**	na	na
Age								
Direct effect	na	**-.15***	.01	na	-.31***	-.13*	**.25*** **	.35***
Indirect effect	na	**-.04* (-.03, -.01)**	.00 (-.01, .01)	na	-.03 (-.23, -.07)	-.10 (-.11, .03)	**.09**(.09, .27**	-.02 (-.02, .06)
Total effect	na	**-.19** **	.00	na	-.34***	-.23**	**.34** **	.33***
Sex								
Direct effect	-.02	.05	-.02	na	.26**	**.28** **	**-.29*** **	-.22*
Indirect effect	.01(-.35, .24)	.02 (-.06, .09)	-.03 (-.04, .03)	na	.01 (-.13, 3.89)	**.21** (.19, 3.00)**	**-.14** (-.30, -4.22)**	-.02 (-.88, 3.90)
Total effect	-.01	..07	-.05	na	.27**	**.49*** **	**-.43*** **	-.24**
Mileage								
Direct effect	**-.24*** **	**.20*** **	**.20*** **	na	.02	.00	.02	.03
Indirect effect	**.05* (-.24, -.03)**	**.06***(.05 .25)**	**.07* (.01 .19)**	na	.00 (-1.12, .89)	.00 (-.82, .97)	.00 (-1.23, 1.00)	.01 (-.91, 1.29)
Total effect	**-.19** **	**.26*** **	**.27** **	na	.02	.00	.02	.04
Experience								
Direct effect	.01	.03	-.15**	.21**	.27***	.10	-.13	**-.24** **
Indirect effect	-.00 (-.01, .01)	.01(-.01, .02)	-.01(-.02, .01)	-.01 (-01, .04)	.03 (-.07, .01)	.08 (-06, .21)	-.02 (-.05, .02)	**-.05* (-.11, .00)**
Total effect	.01	.04	-.16**	.20**	.29***	.18*	-.15*	**-.29** **

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

95% CI (confidence interval, based on 10,000 bias-corrected bootstrapped samples)

N (GH = 478, UK = 404)

na = not applicable

Significant mediation effects are in bold phases

458 *3.4.1.1 Anxiety*

459 The path from anxiety to crash involvement (See Tables 3a-c) was fully mediated by the combined
460 effect of violations and errors; higher levels of anxiety were associated with more frequent
461 violations and errors which predicted higher crash involvement. The paths from anxiety to
462 violations and errors were significant. The indirect paths from anxiety to crash involvement via
463 the mediators, violations and errors, were significant as indicated by the 95% BCa CI's which did
464 not include zero. The direct path from anxiety to crashes (B = .01, p= .94) was non-significant.

465

466 *3.4.1.2 Personality*

467 *3.4.1.2.1 Big Five Personality:* Agreeableness and conscientiousness had direct effects on crashes
468 without passing through a mediator. Both factors were negatively related to crash involvement as
469 shown in Figure 2.Table 3a shows agreeableness predicted violations and errors and
470 conscientiousness predicted errors. However, the indirect paths to crashes from agreeableness and
471 conscientiousness via violations and errors were non-significant; the 95% BCaCI's included zero.
472 The other three dimensions of the Big Five Personality were not independently significant
473 predictors of crash involvement.

474

475 *3.4.1.2.1 Impulsivity;* Impulsivity was related to poor hazard monitoring and predicted crash
476 involvement indirectly via this route. In addition, Figure 2 shows that the direct path between
477 impulsivity and crashes (B = .36, p<.001) was significant. Therefore, hazard monitoring only
478 partially mediated the association between impulsivity and crash involvement and the remaining
479 association was not mediated by errors or violations. The direction of the relationship indicates
480 that higher impulsivity was related to higher crash risk.

481

482 *3.4.1.2.3 Aggression and thrill seeking*

483 There was a significant indirect path between aggression and crash involvement via violations
484 (See Tables 3a-c). Higher aggression was associated with higher violations. As shown in Figure
485 2, the direct path to crash involvement from aggression (B = .09, p<.05) was significant. The
486 association between thrill-seeking and crashes involvement was fully mediated by errors. Higher
487 levels of thrill seeking were related to higher frequency of errors that in turn predicted crash
488 involvement. The direct path from thrill seeking to crash involvement (B = .04, p= .24) was non-
489 significant.

490 *3.4.1.3 Safety attitudes; risk perception and fatalistic beliefs*

3.4.1.3.1 Risk perception: The association between risk perception and crash involvement was fully mediated by significant indirect pathways via hazard monitoring and violations (Table 3a). Lower levels of risk perception were associated with lower levels of hazard monitoring and higher levels of violations that in turn were related to crash propensity. As Figure 2 shows the direct path from risk perception to crashes (B = -.06, p= .06) was non-significant.

3.4.1.3.2 Fatalistic beliefs

Violations and errors jointly mediated the path from fatalistic belief to crash involvement. Stronger fatalistic beliefs were related to higher violation and error frequencies which in turn predicted crash propensity; significant indirect pathways are shown in Table 3b. The direct path from fatalistic beliefs to crash involvement (B = .01, p= .69) was not significant.

3.4.1.4 Distracted driving susceptibility

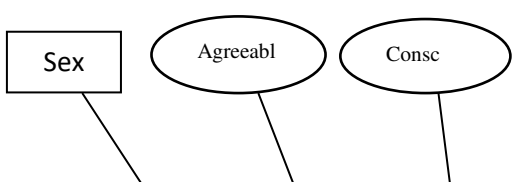
The association of susceptibility to distraction with crash involvement was partially mediated by indirect pathways through hazard monitoring and errors (See Tables 3a-c). Higher levels of distraction were associated with poorer hazard monitoring and higher frequency of errors. As shown by Figure 2, the direct path from distraction to crash involvement (B = .13, p<.01) was also significant, showing mediation was only partial.

3.4.1.5 Maintenance

There were significant indirect pathways (See Tables 3a-c) from maintenance practices to crash involvement via violations and errors. More frequent maintenance practices were related to higher violations and errors that predicted crash propensity. The direct path to crash involvement from maintenance practices (B = .01, p= .81) was not significant.

3.4.1.6 Fatigue

The association between fatigue and crash involvement was fully mediated by indirect paths via violations and errors (See Tables 3a-c). Higher levels of fatigue were associated with higher frequency of violations and errors. The direct path to crash involvement from fatigue (B = .03, p= .59) was non-significant.



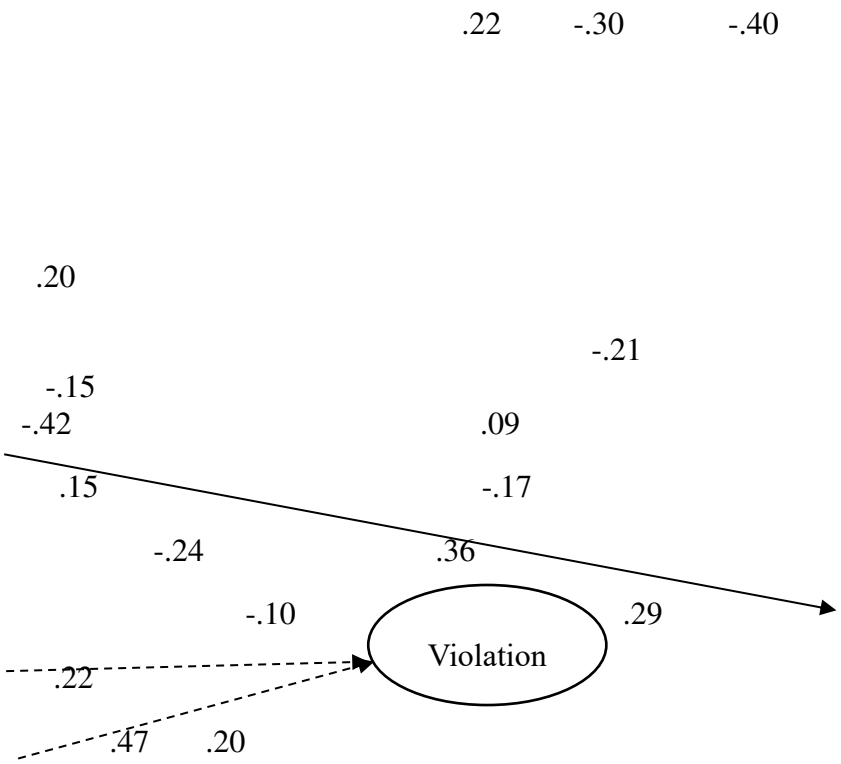


Fig 2 Path diagram: mediation model for the prediction of crash involvement from distal factors via proximal factors in Ghana. Note: Indirect paths are shown in dotted lines and only significant paths are shown.

3.4.2 UK Mediation results

559 The UK model had the same structure as the Ghanaian model except that violations had two
560 components; ordinary and aggressive and there were separate errors and lapses factors. In the UK
561 sample, ordinary violations were highly correlated with aggressive violations (r =.75); errors (r
562 =.54) and lapses (r =.65). These correlations indicate that drivers who frequently commit ordinary
563 violations are also likely to commit aggressive violations and errors. The aggressive violations
564 were highly correlated with errors (r =.70)and with lapses ((r =.65).The path diagram for UK is
565 presented in Figure 3.Four of the 5 proximal pathways to crash involvement specified for the
566 UKwere independently significant; hazard monitoring (B = -.09 p<.05), aggressive violations (B
567 = .15, p<.05), errors (B = .13, p<.05) and lapses (B = .22, p<.001). Ordinary violations were not
568 independently significant (B = .03, p = .06), however. The direction of the effects indicates that
569 lower levels of hazard monitoring and higher frequencies of aggressive violations, errors and
570 lapses were associated with higher crash involvement.

571

572 *3.4.2.1 Anxiety and driver crash risks*

573 Similar to the Ghana analysis, the link to crash involvement from anxiety was partially mediated
574 by errors. Higher levels of anxiety were linked to more frequent errors that were related to higher
575 crash involvement. Unlike the Ghana analyses, however, there was no indirect path from anxiety
576 to crashes via violations; anxiety was associated with aggressive violations but the overall indirect
577 pathway was non-significant. As shown in Figure 3, the direct path to crashes from anxiety was
578 significant(B = .20, p<.01).

579

580 *3.4.2.2 Personality factors and driver crash risks*

581 *3.4.2.2.1 Neuroticism:* The path from neuroticism to crash involvement was fully mediated by
582 hazard monitoring. Higher levels of neuroticism were linked to lower hazard monitoring which
583 predicted higher crash involvement. The direct path from neuroticism to crashes was non-
584 significant (B = .01, p = .41). As shown in Table 3a, the path from neuroticism to hazard
585 monitoring was significant as was the indirect path from neuroticism to crashes via hazard
586 monitoring.

587

588 *3.4.2.2.2 Impulsivity:* The path from impulsivity to crash involvement was partially mediated by
589 errors. Higher levels of impulsivity were associated with more frequent errors which predicted
590 higher crash involvement. The path from impulsivity to crashes (B = .42, p<.001) was significant.

The path from impulsivity to errors and the indirect path from impulsivity to crash involvement via errors were significant (See Tables 3a-c).

3.4.2.2.3 The Big Five Personality Traits: Extraversion and agreeableness were directly related to crash involvement independently from the mediators. Higher extraversion and lower agreeableness was associated with higher risk of crash involvement. The paths from extraversion to hazard monitoring, ordinary violations and errors (See Tables 3a-c) were also significant. The paths from agreeableness to ordinary violations and errors were significant. However, the 95% BCaCI's for the indirect paths from extraversion and agreeableness to crashes included zero, indicating that they were non-significant (p>.05).

3.4.2.3 Thrill seeking: The path from thrill seeking to crash involvement was fully mediated by hazard monitoring, as indicated by the significant indirect path (Tables 3a-c). The direction of the effects was such that higher levels of thrill seeking were associated with lower hazard monitoring which in turn predicted higher crash involvement. The direct path from thrill seeking to crashes (B = .08, p = .11) was not significant.

3.4.2.4Distraction susceptibility

The effect of distraction susceptibility on crash involvement was partially mediated by the combined effect of hazard monitoring and errors(Tables 3a-c).Higher levels of distraction susceptibility predicted lower hazard monitoring and more frequent errors which in turn predicted higher crash involvement. The direct path from distraction susceptibility to crash involvement (B = .17, p<.01) was also significant as shown in Figure 3.

3.4.2.5 Driver stress

Dislike for driving and fatigue predicted crash involvement independently from the mediators as shown in Figure 3. Higher level of dislike for driving and driving when fatigued predicted greater crash involvement. Dislike for driving predicted hazards monitoring and errors while fatigue predicted errors, ordinary violations and aggressive violations (Tables 3a-c). However, the indirect paths to crashes from dislike for driving and fatigue via the mediators were non-significant (p>.05) as the 95% BCaCI's included zero.

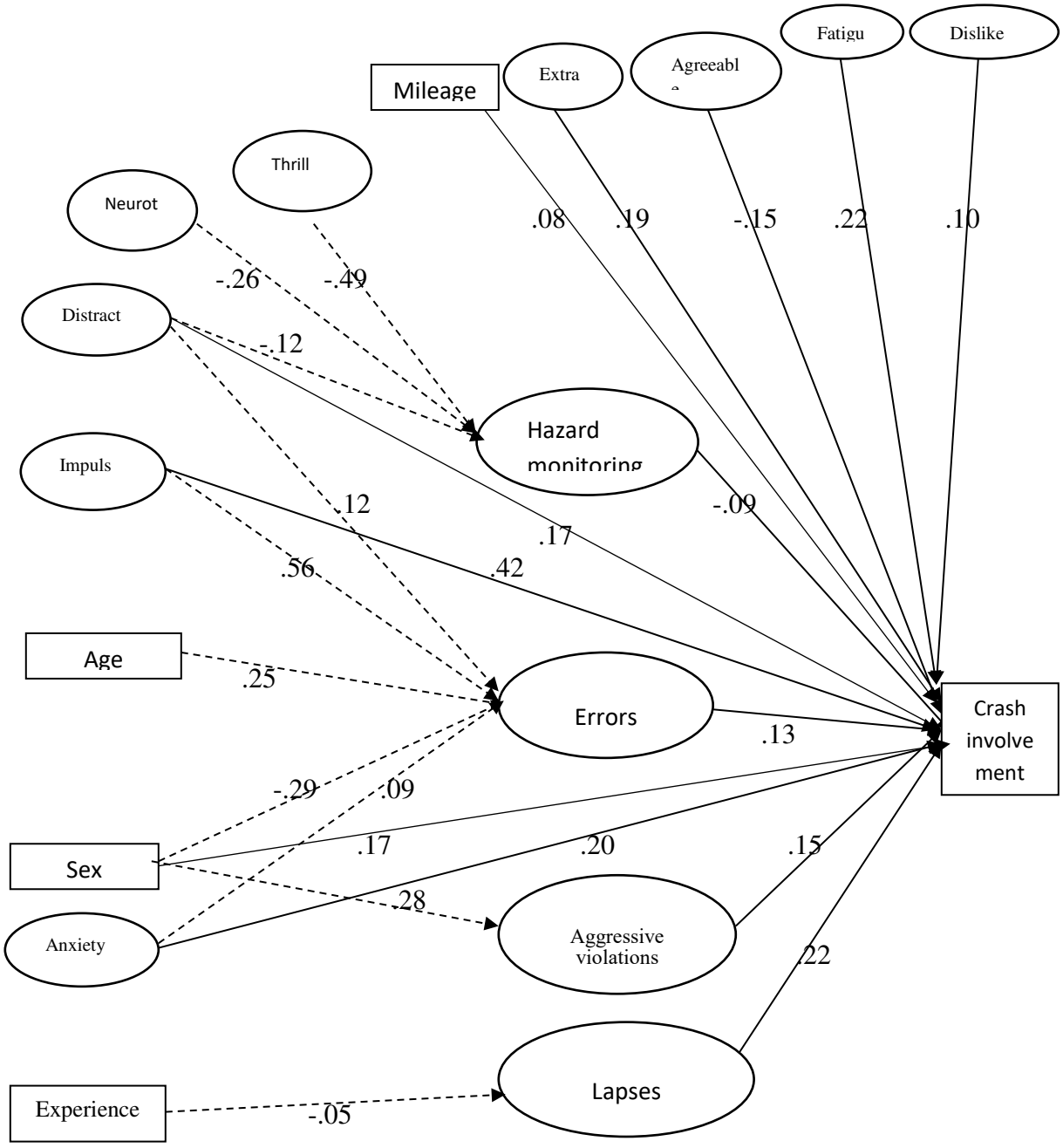


Fig.3. Path diagram: mediation model for the prediction of crash involvement from distal factors via proximal factors in UK. Note: Indirect paths are shown in dotted lines. Only significant paths are shown.

4 Discussions

This study tested a model of the processes underlying risky driving behaviours in Ghana and compared them to the processes underlying risky driving in the UK. Broadly the revised contextual model was useful in understanding the relationships between psychological factors and crash risk in both UK and Ghana. That there are important differences between the countries, however, is illustrated by the differing factor structures of the DBQ. Confirmatory factor analyses showed that, in Ghana, the 24 item 2-factor (errors and violations) structure proposed by Dotse& Rowe (2021) was the best fitting model. By contrast the four-factor structure distinguishing ordinary from aggressive violations and lapses from errors was observed for the UK sample, as is consistent with existing UK DBQ analyses (e.g., Lajunen et al., 2004).

4.1 Proximal factors and crash involvement

Path modelling results showed the relationship between distal factors and crash involvement was mediated by proximal factors in both settings. The proximal factors tested in Ghana; hazard monitoring, violations and errors independently predicted crash involvement while 4 of the 5 proximal factors identified for the UK; hazard monitoring, aggressive violations, errors and lapses independently predicted crash involvement. The relationship found between the behavioural risks and crash involvement from both Ghana and the UK were generally congruent with many existing studies (e.g., de Winter &Dodou, 2010) that have demonstrated that the components of the DBQ are good predictors of crash involvement. In the present study, however, ordinary violations were not independently related to crash involvement in the UK data; the coefficient fell just below significance. However, the simple correlation between ordinary violations and crash involvement was significant with an estimated coefficient of .12 which is compatible with the association of .13 estimated in De Winter et al.'s (2015) meta-analyses. This indicates that ordinary violations did not significantly predict crashes in the mediation model due to correlation with other proximal predictors.

The relationship between hazard monitoring and crash involvement was independently significant in both Ghana and UK with poorer hazard monitoring linked to increased crash risk; this effect is independent of the correlations of hazard monitoring with errors and violations. Therefore, hazard monitoring may be measuring a construct involved in driving risk that is independent of choosing

risky driving styles (violations) and from making mistakes while driving as indexed by DBQ errors (Boufous, Ivers, Senserrick, & Stevenson, 2011; Cheng, Ng, & Lee, 2011). This indicates it may be an important additional construct to measure in self-report studies aiming to understanding the role of driving behaviour in crash involvement in the context of higher and lower income countries. These findings align with studies in high-income HICs, such as Boufous et al. (2011) and Cheng et al. (2011), who found hazard monitoring to be a crucial component of driving safety.

This study tested several hypotheses regarding the relationships between distal factors (e.g., personality, stress, distracted driving susceptibility) and crash involvement, mediated by proximal factors (e.g., violations, errors, hazard monitoring). The key hypotheses and their resolutions are discussed.

4.2 Anxiety and driver crash risks

Anxiety was hypothesised to relate to crash involvement indirectly through all three mediators; hazard monitoring, violations and errors. The results showed that in Ghana, a combination of violations and errors fully mediated the relationship between anxiety and crash involvement. This pattern of results is consistent with the hypothesis that people higher in anxiety engage in more violations and errors which, in turn, increases their crash risk.Both ourfindings from Ghana and existing literature (e.g., Lucidi et al., 2019; Traficante et al., 2024) suggest that violations and errors play a crucial role in linking anxiety to crash involvement. In the UK the path from anxiety to crash involvement was partially mediated by errors but not violations; anxiety related both directly and indirectly to crashes. The link from anxiety to crashes through errors for the UK sample is consistent with existing studies in HICs (Bowen, Budden, & Smith, 2020; Matthews, 2002). Vulnerability to stress that leads to errors among highly anxious drivers were the explanations offered for these relationships (Bowen et al., 2020; Matthews, 2002). Working pressures and demands that often lead to higher anxiety reported among commercial drivers, who are some of the most vulnerable drivers to crashes in Ghana (Dotse et al., 2019) could explain the differences in the mediation links between Ghana and the UK.

4.3 Personality factors and driver crash risks

It was hypothesized that impulsivity would predict crash involvement through hazard monitoring, violations, and errors. The results showed that in Ghana impulsivity related both directly and indirectly through hazard monitoring to crashes (partial mediation) but there was no mediation via violations or errors. One possibility is that hazard monitoring is impaired at higher levels of impulsivity. These results are consistent with studies such as Sumer (2003) and Matthews (2002), who found impulsivity to be a risk factor for crashes due to its influence on risky behaviour and diminished hazard perception. In the UK the path from impulsivity to crash involvement was partially mediated by errors, as expected. The link to crashes from impulsivity through errors for the UK sample is supported by studies in HICs and could be attributed to vulnerability to stress (Matthews, 2002).

It was hypothesized that the Big Five personality dimensions would predict crash involvement indirectly through violations and errors. The results supported this hypothesis for agreeableness and conscientiousness in Ghana, and for extraversion and agreeableness in the UK. In Ghana, of the big-five personality factors, agreeableness and conscientiousness had direct effect on crashes, while in the UK extraversion and agreeableness related to crash involvement directly. These differences may reflect cultural influences on driving behaviour. For instance, other studies have highlighted the importance of cultural context in the impact of personality traits on risky behaviour (e.g., Al-Tit, 2020; Granie et al., 2021; Ulleberg & Rundmo, 2003). In Ghana, violations partially mediated the relationship between aggression and crash involvement. In the UK, neuroticism related indirectly to crash involvement through hazard monitoring. These findings are largely consistent with other studies (e.g., Lucidi et al., 2010; Ulleberg and Rundmo, 2003). Stronger path coefficients for the indirect effects of personality to risky driving behaviours (mediators) than the direct effects of personality on crash involvement were observed, indicating that the majority of the relationship between personality and crash involvement was explained by variations in the proximal measures of driving behaviour included in this study. These patterns of effects were similar to those observed in Sumer's model (Sumer, 2003). In Sumer's model, personality factors predicted crash involvement via their effects on driving behaviours. However relatively weaker path coefficients were observed between the personality factors and crash involvement than from personality to risky driving behaviours (Sumer, 2003). It is possible that the direct effect is mediated by some form of behaviour that is not fully captured by the mediating variables measured

in the current study, such as safety orientation/skills (Lajunen, Parker & Stradling, 1998). The results of the present study suggest personality factors are important to crash prediction in both Ghana and UK but interventions targetedto reduce these effects may need to be targeted at different risky driving behaviour in each country.

In Ghana, errors fully mediated the path between thrill-seeking and crash involvement, contrary to expectation. Violations and errors were both moderately correlated with thrill-seeking in Ghana (See Appendices; Tables3a-c). Although they are correlated, the model identified that the independent mediation involves errors rather than violations. It is often found that thrill-seeking relates to errors and crash involvement (Zhang et al., 2019). In our UK data, however, although there were simple correlations between thrill seeking and both errors and violations, the mediation model showed hazard monitoring fully mediated the relationship between thrill and crash involvement, contrary to expectation. This is consistent with the possibility that thrill seeking impairs hazard monitoring and this leads to crashes. Similar to the relationship observed in our results, hazard monitoring has been found to correlate negatively with thrill seeking elsewhere (e.g., Öz, Özkan, &Lajunen, 2010).

4.4 Safety attitudes; fatalistic beliefs, risk perception, maintenance behaviour and driver crash risks

Besides personality factors, the present study addressed the role of a range of attitudes; fatalistic beliefs, risk perception and maintenance practices as distal predictors of crash involvement. Most of these distal factors performed a role in Ghana but not in the UK. It was hypothesized that fatalistic beliefs would relate to crash involvement through violations. The results supported this hypothesis in Ghana showing that stronger fatalistic beliefs were associated with violation frequency, which in turn was associated with crash propensity whereas this relationship was not significant in the UK. Interestingly the path between fatalistic beliefs and crash involvement was partially mediated by both violations and errors in Ghana. One possibility is that drivers who believe crashes are the result of supernatural forces believe that risky and careless driving will have less implications for crash risk. Fatalistic beliefs have been found to influence work injuries in general as they have a negative influence on a range of risk assessment and risk-taking behaviours (Mbebeb, 2020; McIlroy et al., 2022; Slovic, Fischhoff, & Lichtenstein, 1981).This

778 factor may be more important to driver crash prediction in the Global South (Teye-Kwadjo, 2019).
779 Themes of spiritual influences on crashes were prominent in a qualitative exploratory study on
780 crash risks factors in Ghana (Dotse et al., 2019). Educational interventions have been demonstrated
781 to be effective in developing safer driving behaviours (Tirla et al., 2024). It may be effective to
782 target Ghanaian motorists' beliefs regarding fatalism with psychoeducational interventions.
783
784 It was hypothesized that risk perception would relate to crash involvement through hazard
785 monitoring and violations. In the Ghanaian sample risk perception related indirectly to crashes
786 through the combined effect of hazard monitoring and violations (full mediation) as expected. In
787 the UK sample, where risk perception correlated moderately with the DBQ factors, the pathway
788 to crash involvement was not mediated. The direction of the effect in the Ghanaian data indicated
789 that lower perceived risk was related to higher rates of violation and lower level of hazard
790 monitoring which in turn predict crash involvement. These findings are similar to those reported
791 in HICs (e.g., Kummeneje, & Rundmo, 2020; Yuang et al., 2021).
792
793 Moderate positive correlations were found between distraction susceptibility and DBQ factors
794 while distraction susceptibility related negatively to hazard monitoring in Ghana and the UK. As
795 hypothesised, the effect of distraction on crash involvement was partially mediated by the
796 combined effect of hazard monitoring and errors in Ghana and UK. This underscores the dangers
797 of engaging in distracting activities while driving in both HICs and LMICs as highlighted in other
798 work (e.g., Diegelmann et al., 2020; Ponte et al., 2021; Shaaban et al., 2020; Wundersitz, 2019).
799
800 The condition of a driver's vehicle has been proposed as an important factor that can contribute to
801 crashes (af-Wahlberg, 2004). We hypothesized that safety maintenance practices would impact
802 crash involvement via errors. In our UK sample we found poor maintenance practices were related
803 to crash involvement, consistent with other work addressing this in HICs (United States Federal
804 Motor Carrier Safety Administration [FMCSA], 2006). In Ghana, frequent maintenance practices
805 were paradoxically associated with increased violations and errors. This contrasts with findings
806 from HICs, where poor maintenance correlates with higher crash risks (e.g., Assemi, Hickman, &
807 Paz, 2021;Haq, Zlatkovic, &Ksaibati, 2020; Haq, Ampadu, &Ksaibati, 2023).The path between
808 maintenance practices and crash involvement was fully mediated via a combination of violations

and errors. Unlike in HICs the use of poorly maintained vehicles, mostly for commercial passenger and goods transportation, is characteristic of Ghana and other countries in Africa. Many passenger transportation vehicles were not designed for this purpose and were modified locally for use as commercial passenger vehicles (See Dotse et al., 2019). One possible explanation for the Ghanaian findings is that the more frequently drivers maintain their vehicles, the better the condition of the vehicle which encourages risky driving behaviour such as speeding. Alternatively, people who are comfortable taking risks may be more likely to own vehicles that are less roadworthy and therefore require frequent maintenance. The relationships between maintenance behaviours and risky driving warrant further research in Ghana.

4.5 Effect of stress and fatigue on driver crash risks

It was hypothesized that driver stress and fatigue would relate to crash involvement through violations, errors, and hazard monitoring. The results showed that in Ghana the path between fatigue and crash involvement was fully mediated by a combination of violations and errors as was expected on the basis ofdata from HICs (e.g.,Bener et al., 2017). In the UK dislike for driving and fatigue related directly to crash involvement rather than via any of the mediators and is congruent with existing literature (Al-Mekhlafi., Isha, & Naji, 2020).As this study is cross-sectional, the direction of effect here could mean that people who have experienced a crash enjoy driving less. No mediation path was found for the stress indices in the UK. Long hours of work found among commercial drivers in Ghana (Dotse et al., 2019) may lead to the fatigue that was found to increase violations and errors leading to crashes (Haworth, 1995). In HICs such as the UK, regulations (e.g., tachograph rules) that prevent long working hours may mitigate the effect of fatigue on driving behaviour.

4.6 Limitations

There are some limitations to this study. First, this study was correlational; thus, causal inferences cannot be made. Although longitudinal data allow some stronger inferences concerning temporal ordering of variable associations, causal statements would still not be certain. More complex quasi-experimental designs (Jaffee, Strait, & Odgers, 2012) would be useful to strengthen the causal

evidence base. Second, common-method variance may have contributed to prediction across exogenous and mediator variables as data were based on self-report. Given the nature of the problem studied, and particularly the context of LMICs, it was not possible to obtain objective information on crashes or driving behaviour. Further work validating the DBQ with objective crash measures in the Global South and with larger samples would be advantageous. Hazard monitoring was measured through self-reports in the present study but the concept is typically measured through video simulations (e.g., Horswill et al, 2020). However, the self-report measure of hazard monitoring was effective in predicting the dimensions of the DBQ in a validation study (Mathews et al., 1997) and for commercial drivers in the Ghana sample but not in the UK sample; and was associated with crash involvement independently from DBQ errors in the present study. Testing the role of objectively measured hazard perception would be useful in understanding the mechanisms through which self-reported hazard monitoring plays its role.

The differences in sample characteristics between the UK and Ghana are significant and likely influenced the driving behaviours observed and the findings of this study. The Ghanaian sample had a higher proportion of commercial drivers, who may exhibit different driving behaviours compared to non-commercial drivers. Commercial drivers often face unique pressures and challenges, such as longer driving hours and stricter schedules, which can impact their driving behaviour and crash risk. In contrast, the UK sample, with a higher proportion of private drivers, may exhibit different patterns of driving behaviour. These disparities underscore the importance of considering contextual factors when comparing driving behaviours across different countries.

Additionally, the socio-economic, infrastructural, and regulatory environments in Ghana and the UK are vastly different, which likely influenced the study's findings. In Ghana, limited resources for vehicle maintenance and less stringent traffic law enforcement may contribute to higher crash risks. These contextual differences must be taken into account when generalizing the results to other settings. The findings highlight the need for tailored interventions that address the specific challenges faced by drivers in different countries.

An additional limitation of the study is that the Ghanaian sample was biased towards commercial drivers, which may limit the generalisability of the findings to non-commercial drivers. Furthermore, the gender split was not balanced, with a higher proportion of male drivers

(commercial drivers in Ghana are predominantly males [Boadi-Kusi et al., 2016]) in both samples, a disparity that was particularly marked in the Ghanaian sample.

4.7 Conclusion

We found that distal factors related to crash involvement via proximal factors in Ghana and the UK. Overall, the findings provide empirical support to the revised contextual mediated model (following Sumer, 2003) to explain driving behaviour in Ghana as well as the UK. More mediating paths were observed for Ghana than the UK despite the higher number of mediators included in the UK models. This could be attributed to the revision process of the contextual mediated model that included some factors (e.g., beliefs) likely to be more important in the Ghanaian setting. Alternatively, the differences could also be attributed to higher rates of violations and errors reported by the Ghanaian sample compared to the UK sample that could mean a stronger relationship among the variables in Ghana. Regulation and enforcement may be less rigorous in Ghana than the UK (Dotse et al., 2019) which might mean that driving behaviour is more closely linked to crash involvement (Dotse & Rowe, 2021). Differences in the rating of many of the factors (e.g., fatigue) between Ghana and the UK could result from cultural differences in the interpretation of the items. The results from the present study suggest that the revised contextual model can partly explain the process underlying risky driving behaviours among drivers in Ghana and the UK. However, the differences in the results between the two settings show that the model may not be applied universally to all cultures. In comparison to the original contextual mediated model (Sumer, 2003), the present model had relatively more significant paths.

This study has several strengths. First, it applies a revised Contextual Mediated Model to both Ghanaian and UK samples, allowing for cross-cultural comparisons. Second, it includes a large sample size from both countries, enhancing the generalisability of the findings. Third, the study uses robust statistical methods, including Confirmatory Factor Analysis and Structural Equation Modelling, to validate the model and test the hypothesized relationships. As discussed above, findings from this study have implications for safety policies and interventions to reduce road crash fatalities in LMICs.

References

Ābele, L., Haustein, S., Møller, M., &Martinussen, L. M. (2018). Consistency between subjectively and objectively measured hazard perception skills among young male drivers. *Accident Analysis & Prevention*, *118*, 214-220.

afWåhlberg, A. E. (2004). The stability of driver acceleration behaviour, and a replication of its relation to bus accidents. *Accident Analysis & Prevention, 36*(1),83–92. doi.org/10.1016/S0001-4575(02)00130-6

Al-Mekhlafi, A. B. A., Isha, A. S. N., & Naji, G. M. A. (2020). The relationship between fatigue and driving performance: A review and directions for future research. *J. Crit. Rev*, *7*(14), 134-141.

Al-Tit, A. A. (2020). The impact of drivers' personality traits on their risky driving behaviors. *Journal of human behavior in the social environment*, *30*(4), 498-509.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological bulletin*, *103*(3), 411.

Assemi, B., Hickman, M., & Paz, A. (2021). Relationship between programmed heavy vehicle inspections and traffic safety. *Transportation research record*, *2675*(10), 1420-1430.

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 (English edition)*, *4*(5), 496-502.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*(2), 238-246. Retrieved from https://escholarship.org/uc/item/6cn677bx

Boadi-Kusi, S. B., Kyei, S., Asare, F. A., Owusu-Ansah, A., Awuah, A., & Darko-Takyi, C. (2016). Visual function among commercial vehicle drivers in the central region of Ghana. *Journal of optometry*, *9*(1), 54-63.

Boufous, S., Ivers, R., Senserrick, T., & Stevenson, M. (2011). Attempts at the practical on-road driving test, the hazard perception test, and the risk of traffic crashes in young drivers. *Traffic Injury Prevention*, *12*(5), 475-482. doi:10.1080/15389588.2011.591856

Bowen, L., Budden, S. L., & Smith, A. P. (2020). Factors underpinning unsafe driving: A systematic literature review of car drivers. *Transportation research part F: traffic psychology and behaviour*, *72*, 184-210.

Byrne, B. M. (2013). *Structural equation modelling with AMOS: Basic concepts, applications, and programming*. New York: Routledge.

Cheng, A. S., Ng, T. C., & Lee, H. C. (2011). A comparison of the hazard perception ability of accident-involved and accident-free motorcycle riders. *Accident Analysis & Prevention*, *43*(4), 1464-1471.

Coleman, A. (2014). Road traffic accidents in Ghana: A public health concern, and a call for action in Ghana, (and the Sub-Region). *Open Journal of Preventive Medicine*, *4*(11), 822.doi.org/10.4236/ojpm.2014.411092

Constantinou, E., Panayiotou, G., Konstantinou, N., Loutsiou-Ladd, A., &Kapardis, A. (2011). Risky and aggressive driving in young adults: Personality matters. *Accident Analysis& Prevention*, *43*(4), 1323-1331. doi.org/10.1016/j.aap.2011.02.002

de Winter, J. C. F., &Dodou, D. (2010). The Driver Behaviour Questionnaire as a predictor of accidents: A meta-analysis. *Journal of Safety Research*, *41*(6), 463-470. doi.org/10.1016/j.jsr.2010.10.007

de Winter, J. C., Dodou, D., &Stanton, N. A. (2015). A quarter of a century of the DBQ: some supplementary notes on its validity with regard to accidents. *Ergonomics*, *58*(10), 1745-1769. doi.org/10.1080/00140139.2015.1030460.

Delhomme, P., & Gheorghiu, A. (2021). Perceived stress, mental health, organizational factors, and self-reported risky driving behaviors among truck drivers circulating in France. *Journal of safety research*, *79*, 341-351.

Department for Transport. (2023). *Reported Road Casualties Great Britain: 2022*. National Statistics. https://www.gov.uk/government/statistics/reported-road-casualties-great-britain-annual-report-2022/reported-road-casualties-great-britain-annual-report-2022#:~:text=In%20reported%20road%20collisions%20in,of%2012%25%20compared%20to%202019

Diegelmann, S., Ninaus, K., &Terlutter, R. (2020). Distracted driving prevention: An analysis of recent UK campaigns. *Journal of Social Marketing*, *10*(2), 243-264.

Dotse, J. E., & Rowe, R. (2021). Modelling Ghanaian road crash risk using the Manchester driver behaviour Questionnaire. *Safety science*, *139*, 105213.

Dotse, J., Nicolson, R., & Rowe, R. (2019). Behavioral influences on driver crash risks in Ghana: A qualitative study of commercial passenger drivers. *Traffic Injury Prevention*, *20*(2), 1-6.doi: 10.1080/15389588.2018.1556792

Dula, C. S., Adams, C. L., Miesner, M. T., & Leonard, R. T. (2010). Examining relationships between anxiety and dangerous driving. Accident Analysis and Prevention, 42, 2050–2056. https://doi.org/10.1016/j.a.ap. 2010.06.016.

European Commission (2024) Annual statistical report on road safety in the EU, 2024. *European Road Safety Observatory*. Brussels, European Commission, Directorate General for Transport. https://road-safety.transport.ec.europa.eu/document/download/b30e9840-4c22-4056…

Evans, L. (2000). Risks older drivers face themselves and threats they pose to other road users. *International Journal of Epidemiology*, *29*(2), 315-322. doi.org/10.1093/ije/29.2.315

Feng, J., Marulanda, S., &Donmez, B. (2014). Susceptibility to Driver Distraction Questionnaire: development and relation to relevant self-reported measures. *Transportation Research Record: Journal of the Transportation Research Board*, (2434), 26-34. doi.org/10.3141/2434-04

FMCSA (2006). Federal Motor Carrier Safety Administration Report, 2006. Retrieved from https://www.fmcsa.dot.gov › Safety › Data & Statistics

Ge, Y., Qu, W., Jiang, C., Du, F., & Kan-Zhang, X. (2014). The effect of stress and personality on dangerous driving behaviour among Chinese drivers.*Accident Analysis & Prevention, 73,* 34–40. doi.org/10.1016/j.aap.2014.07.024

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,* 100–110.doi.org/10.1016/j.aap.2013.11.017

Granie, M. A., Thevenet, C., Varet, F., Evennou, M., Oulid-Azouz, N., Lyon, C., ... & Van den Berghe, W. (2021). Effect of culture on gender differences in risky driver behavior through comparative analysis of 32 countries. *Transportation research record*, *2675*(3), 274-287.

Haq, M. T., Ampadu, V. M. K., &Ksaibati, K. (2023). An investigation of brake failure related crashes and injury severity on mountainous roadways in Wyoming. *Journal of safety research*, *84*, 7-17.

Haq, M. T., Zlatkovic, M., &Ksaibati, K. (2020). Assessment of tire failure related crashes and injury severity on a mountainous freeway: Bayesian binary logit approach. *Accident Analysis & Prevention*, *145*, 105693.

991 Haworth, N. (1995). *Fatigue and Driving: Driver Impairment, Driver Fatigue, And Driving*
992 *Simulation* . London: Taylor and Francis Ltd
993 Hesse, C. A., & Ofosu, J. B. (2014). Comparative analysis of regional distribution of the rate of
994 road traffic fatalities in Ghana. *Open Science Repository Mathematics*, (open-access),
995 e45011802.
996 Horswill, M. S., Hill, A., & Jackson, T. (2020). Scores on a new hazard prediction test are
997 associated with both driver experience and crash involvement. *Transportation research part*
998 *F: traffic psychology and behaviour*, *71*, 98-109.
999 Hu, L. T., &Bentler, P. M. (1999). Cut-off criteria for fit indexes in covariance structure analysis:
1000 Conventional criteria versus new alternatives. *Structural Equation Modelling: A*
1001 *Multidisciplinary Journal*, *6*(1), 1-55.doi.org/10.1080/10705519909540118
1002 Iversen, H., &Rundmo, T. (2004). Attitudes towards traffic safety, driving behaviour and accident
1003 involvement among the Norwegian public. *Ergonomics*, *47*(5), 555-
1004 572.doi.org/10.1080/00140130410001658709
1005 Jaffee, S. R., Strait, L. B., & Odgers, C. L. (2012). From correlates to causes: can quasi-
1006 experimental studies and statistical innovations bring us closer to identifying the causes of
1007 antisocial behavior? *Psychological Bulletin*, *138*(2), 272-295. doi: 10.1037/a0026020
1008 John, 0. P. (1990). *The "Big Five" factor taxonomy: Dimensions of personality in the natural*
1009 *language and in questionnaires'.* In: Pervin, L. (Ed), Handbook of Personality Theory and
1010 Research, Guilford, New York, NY, pp. 66-100
1011 Kouabenan, D. R. (1998). Beliefs and the perception of risks and accidents. *Risk Analysis*, *18*(3),
1012 243-252. doi.org/10.1111/j.1539-6924.1998.tb01291.x
1013 Kummeneje, A. M., &Rundmo, T. (2020). Attitudes, risk perception and risk-taking behaviour
1014 among regular cyclists in Norway. *Transportation research part F: traffic psychology and*
1015 *behaviour*, *69*, 135-150.
1016 Lagarde, E. (2007). Road traffic injury is an escalating burden in Africa and deserves proportionate
1017 research efforts. *PLoS Medicine*, *4*(6), e170-e175. doi.org/10.1371/journal.pmed.0040170
1018 Lagarde, E., Chastang, J. F., Gueguen, A., Coeuret-Pellicer, M., Chiron, M., &Lafont, S. (2004).
1019 Emotional stress and traffic accidents: the impact of separation and divorce. *Epidemiology*
1020 *15(6),* 762–766. doi: 10.1097/01.ede.0000142140.77194.ad

Lajunen, T., Parker, D., & Stradling, S. G. (1998). Dimensions of driver anger, aggressive and Highway Code violations and their mediation by safety orientation in UK drivers. *Transportation Research Part F: Traffic Psychology and Behaviour*, *1*(2), 107-121.doi.org/10.1016/S1369-8478(98)00009-6

Lajunen, T., Parker, D., &Summala, H. (2004). The Manchester driver behaviour questionnaire: a cross-cultural study. *Accident Analysis & Prevention*, *36*(2), 231-238.doi.org/10.1016/S0001-4575(02)00152-5

Lucidi, F., Giannini, A. M., Sgalla, R., Mallia, L., Devoto, A., & Reichmann, S. (2010). Young novice driver subtypes: relationship to driving violations, errors and lapses. *Accident Analysis & Prevention*, *42*(6), 1689-1696.

Lucidi, F., Girelli, L., Chirico, A., Alivernini, F., Cozzolino, M., Violani, C., & Mallia, L. (2019). Personality traits and attitudes toward traffic safety predict risky behavior across young, adult, and older drivers. *Frontiers in psychology*, *10*, 536.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, *7*(1), 83.doi.org/10.1037/1082-989X.7.1.83

Matthews, G. (2002). Towards a transactional ergonomics for driver stress and fatigue. *Theoretical Issues in Ergonomics Science, 3(2), 195–211*.doi.org/10.1080/14639220210124120

Matthews, G., Desmond, P. A., Joyner, L., Carcary, B., & Gilliland, K. (1997). A comprehensive questionnaire measure of driver stress and affect. in CarbonellVaya, E &Rothengatter,J. A. (eds). *Traffic and Transport Psychology: Theory and Application*, (pp. 317-324).Amsterdam: Pergamon.

Mattsson, M. (2012). Investigating the factorial invariance of the 28-item DBQ across genders and age groups: an exploratory structural equation modelling study. *Accident Analysis & Prevention,48,* 379–396. doi.org/10.1016/j.aap.2012.02.009

Mbebeb, F. E. (2020). Occupational Fatalism as Predictor of Risk Behavior Patterns of Workers in High-Risk Work Settings. *International Journal of Applied*, *10*(2), 32-42.

McCarty, D., & Kim, H. W. (2024). Risky behaviors and road safety: An exploration of age and gender influences on road accident rates. *PLoS one*, *19*(1), e0296663.

McIlroy, R. C., Mont'Alvão, C., Cordovez, S. P., Vásconez-González, J., & Prado, E. O. (2022). The influence of fatalistic beliefs and risk perceptions on road safety attitudes in Latin

America; A two-country study. *Transportation research part F: traffic psychology and behaviour*, *90*, 84-99.

Meule, A., Mayerhofer, M., Gründel, T., Berker, J., Beck Teran, C., & Platte, P. (2015). Half-year retest-reliability of the Barratt Impulsiveness Scale–short form (BIS-15). *Sage Open*, *5*(1), 2158244015576548.

Mohan, D. (2002). Road safety in less-motorized environments: future concerns. *International Journal of Epidemiology*, *31*(3), 527-532. doi.org/10.1093/ije/31.3.527

Muthen, L.K., &Muthen, B.O. (2012). *Mplus User's Guide, Seventh ed*. Los Angeles, CA: Muthén&Muthén.

National Road Safety Commission (2016). *Road crash statistics for 2015.* Ghana: National Road Safety Commission.

Newnam, S. A., Watson, B. C., & Murray, W. (2002). A comparison of the factors influencing the safety of work-related drivers in work and personal vehicles. *Proceedings of the 2002 Road Safety Research, Policing and Education Conference.*(pp.488-495). Adelaide: Transport SA.

Nordfjærn, T., Şimşekoğlu, Ö., &Rundmo, T. (2014). Culture related to road traffic safety: a comparison of eight countries using two conceptualizations of culture. *Accident Analysis & Prevention*, *62*, 319-328. doi.org/10.1016/j.aap.2013.10.018

Olson, R. L., Hanowski, R. J., Hickman, J. S., &Bocanegra, J. (2009). *Driver Distraction in Commercial Vehicle Operations*. Virginia Tech Transportation Institute, Department of Transportation, Blackburg, VA.

Öz, B., Özkan, T., & Lajunen, T. (2010). Professional and non-professional drivers' stress reactions and risky driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, *13*(1), 32-40.doi.org/10.1016/j.trf.2009.10.001

Petridou, E., &Moustaki, M. (2000). Human factors in the causation of road traffic crashes. *European Journal of Epidemiology*, *16*(9), 819 826.doi.org/10.1023/A:1007649804201

Ponte, G., Edwards, S. A., &Wundersitz, L. (2021). The prevalence of in-vehicle driver distraction in moving traffic. *Transportation research part F: traffic psychology and behaviour*, *83*, 33-41.

Poulter, D. R., & McKenna, F. P. (2010). Evaluating the effectiveness of a road safety education intervention for pre-drivers: An application of the theory of planned behaviour. *British journal of educational psychology*, *80*(2), 163-181.

Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *Journal Of Research In Personality*, *41*(1), 203-212.doi.org/10.1016/j.jrp.2006.02.001

Reason, J., Manstead, A., Stradling, S., Baxter, J., & Campbell, K. (1990). Errors and violations on the roads: a real distinction? *Ergonomics*, *33*(10-11), 1315-1332.doi.org/10.1080/00140139008925335

Rowden, P., Matthews, G., Watson, B., & Biggs, H. (2011). The relative impact of work-related stress, life stress and driving environment stress on driving outcomes. Accident Analysis and Prevention, 43(4), 1332–1340. https://doi.org/10.1016/j.aap.2011.02.004.

Satorra, A., &Bentler, P. (1988). *Scaling corrections for statistics in covariance structure analysis.* Retrieved from: https://escholarship.org/uc/item/3141h70c

Shaaban, K., Gaweesh, S., & Ahmed, M. M. (2020). Investigating in-vehicle distracting activities and crash risks for young drivers using structural equation modeling. *PLoS one*, *15*(7), e0235325.

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1981). Perceived risk: psychological factors and social implications. *Proceedings of the Royal Society of London. A. Mathematical and Physical Sciences*, *376*(1764), 17-34. doi.org/10.1098/rspa.1981.0073

Spinella, M. (2007). Normative data and a short form of the Barratt Impulsiveness Scale. *International Journal of Neuroscience*, *117*(3), 359-368.doi.org/10.1080/00207450600588881

Stanojević, P., Lajunen, T., Jovanović, D., Sârbescu, P., &Kostadinov, S. (2018). The driver behaviour questionnaire in South-East Europe countries: Bulgaria, Romania and Serbia. *Transportation Research Part F: Traffic Psychology and Behaviour*, *53*, 24-33.doi.org/10.1016/j.trf.2017.12.011

Staton, C., Vissoci, J., Gong, E., Toomey, N., Wafula, R., &Abdelgadir. J. (2016). Road Traffic Injury Prevention Initiatives: A Systematic Review and Meta-summary of Effectiveness in Low and Middle Income Countries. *PLoS ONE 11*(1): e0144971. doi:10.1371/journal.pone.0144971

Stradling, S. G., Parker, D., Lajunen, T., Meadows, M. L., &Xiel, C. Q. (2000). Normal behavior and traffic safety: Violations, errors, lapses and crashes. In *Transportation, Traffic Safety*

and Health—Human Behavior: Fourth International Conference, Tokyo, Japan, 1998 (pp. 279-295). Springer Berlin Heidelberg.

Sümer, N. (2003). Personality and behavioral predictors of traffic accidents: Testing a contextual mediated model. *Accident Analysis & Prevention, 35*(6), 949–964. doi.org/10.1016/s0001-4575 (02)00103-3

Teye-Kwadjo, E. (2019). Risky driving behaviour in urban Ghana: the contributions of fatalistic beliefs, risk perception, and risk-taking attitude. *International Journal of Health Promotion and Education*, 1-18.doi:10.1080/14635240.2019.1613163

Tirla, L., Sârbescu, P., &Rusu, A. (2024). Assessing the effectiveness of psychoeducational interventions on driving behavior: A systematic review and meta-analysis. *Accident Analysis & Prevention*, *199*, 107496.https://doi.org/https://doi.org/10.1016/j.aap.2024.107496

Traficante, S., Tinella, L., Lopez, A., Koppel, S., Ricciardi, E., Napoletano, R., ... &Caffò, A. O. (2024). "Regulating my anxiety worsens the safety of my driving": The synergistic influence of spatial anxiety and Self-regulation on driving behavior. *Accident Analysis & Prevention*, *208*, 107768.

Ulleberg, P., &Rundmo, T. (2003). Personality, attitudes and risk perception as predictors of risky driving behaviour among young drivers. *Safety Science, 41*(5), 427–443.doi.org/10.1016/S0925-7535(01)00077-7

Wong, I. Y., Mahar, D., & Titchener, K. (2014). Driven by distraction: Investigating the effects of anxiety on driving performance using the attentional control theory. Journal of Risk Research, 18(10), 1293–1306. https://doi.org/10.1080/13669877.2014.919516.

World Health Organization (2018). *Global status report on road safety.* Geneva: World Health Organization.

World Health Organization (2018). *WHO country cooperation strategy at a glance: Ghana* (No. WHO/CCU/18.02/Ghana). Geneva, Switzerland: Author; 2018.

World Health Organization (2023). . Global status report on road safety 2023. Geneva: World Health Organization; 2023. Licence: CC BY-NC-SA 3.0 IGO

World Health Organization (2023). *Global status report on road safety.* Geneva: World Health Organization

1143 Wundersitz, L. (2019). Driver distraction and inattention in fatal and injury crashes: Findings from
1144 in-depth road crash data. *Traffic injury prevention*, *20*(7), 696-701.
1145 Yuan, Y., Yang, M., Guo, Y., Rasouli, S., Gan, Z., & Ren, Y. (2021). Risk factors associated with
1146 truck-involved fatal crash severity: Analyzing their impact for different groups of truck
1147 drivers. *Journal of safety research*, *76*, 154-165.
1148 Zhang, X., Qu, X., Tao, D., & Xue, H. (2019). The association between sensation seeking and
1149 driving outcomes: A systematic review and meta-analysis. *Accident Analysis & Prevention*,
1150 *123*, 222-234. https://doi.org/https://doi.org/10.1016/j.aap.2018.11.023

APPENDICES

Table 1 Fit indices for the measurement and structural models fitted to the Ghanaian data

Model	χ^2	df	CFI	TLI	RMSEA (90% CI)	TRd	Δdf
CFA Model							
M1a: measurement model	725.20	153	.94	.92	.09 (0.08 – 0.11)		
SEM Model							
M2: Partial mediation	390.41	70	.90	.87	.08 (0.07–0.12)	23.81**	1
M3: Full mediation	414.22	71	.91	.89	.12 (0.11 – 0.13)		

*Notes: χ^2 = chi-square; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; CI = Confidence Interval; TRd = Sattora-Bentler Scaled Chi-Square Difference; ** = p<0.001*

Table 2 Fit indices for the tested models; measurement and structural for UK data

Model	χ^2	df	CFI	TLI	RMSEA (90% CI)	TRd	Δdf
CFA Model							
M1b: measurement model	682.67	102	.96	.95	.09 (.07 – .11)		
SEM Model							
M2: Partial mediation	401.410	95	.90	.87	.09 (.07–.10)	21.69**	1
M3: Full mediation	612.39	101	.89	.86	.10 (.10 – .15)		

*Notes: χ^2 = chi-square; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; CI = Confidence Interval; TRd = Sattora-Bentler Scaled Chi-Square Difference; ** = p< .001*

Appendix D, Table 1: Correlations among continuous scale scores

Variable	Anx		Imp		Extrv		Agreab		Consc.		Neuro		Open		Belief		Risk	
	GH	**UK**	**GH**	**UK**	**GH**	**UK**	**GH**	**UK**	**GH**	**UK**	**GH**	**UK**	**GH**	**UK**	**GH**	**UK**	**GH**	**UK**
Anxiety	1	1																
Impulsivity	-.07	.68***	1	1														
Extraversion	.12*	.13**	.07	.16**	1	1												
Agreeableness	.10*	.01	.01	-.01	.05	-.28**	1	1										
Conscienti.	.06	-.01	-.16**	-.04	-.06	-.47***	.02	.74**	1	1								
Neuroticism	.04	.13**	.12**	.15**	.24**	.38***	-.03	-.08	-.06	.15**	1	1						
Openness	-.09*	-.03	-.32***	-.08	-05.*	-.47***	.01	.71**	-.09	-.90***	.13**	-.163	1	1				
Beliefs	.04	-.14**	.16**	-.16**	.19**	-.02	-.01	.02	-.10**	-.-03	.65***	.07	-.11*	-.09	1	1		
Risk perception	.00	-.12*	-.09	-.10*	.03	-.26**	.03	.12*	.02	.27**	-.60***	-.05	.13**	.28**	-.64***	.03**	1	1
Aggression	.05	.17**	.25**	.11*	.26**	.36***	.05	-.27**	-.03	.37***	.46***	.04	-.07	-.36***	.46***	-.10**	-.43***	-.09**
Dislike	.01	.06	.17**	.08	.23**	.46***	-.01	-.34***	-.11*	-.45***	.47***	.19**	.05	-.47***	.45***	.10**	-.37***	-.14**
Hazard Monitoring	-.04	-.05	-.01	-.01	.04	-.37***	.00	.28**	-.09	-.40***	-.21**	-.04	-.09	.40***	-.16**	-.01**	.22**	.27**
Fatigue	.03	.06	.12**	.04	.29**	.35***	-.04	-.28**	-.06	-.35***	.37***	.13*	.05	-.37***	.40***	.10*	-.29	-.09
Thrill	.03	.07	.16**	.04	.20**	.34**	-.08	-.34***	-.06	-.39***	.45***	-.01	-.05	-.43***	.45***	.04	-.39***	-.28
Distraction	.07	.07	.16**	.15**	.24**	.07	.08	-.03	-.07	-.07	.51***	.01	-.16**	-.09	.49***	.13**	-.44***	-.17**
Maintenance	.05	.01	-.12*	-.02	-.17**	.02	.14**	-.04	.16**	-.00	-.22**	.08	.02	.04	-.09	-.15**	.02	.02
Violations	.45***		.13**		.22**		-.02		-.10*		.36***		-.02		.36***		-.19**	
Ord. violations		.20**		.30**		.26**		-.17**		-.18**		.11*		-.18**		-.07		-.22**
Agg. Violations		.26**		.42**		.18**		-.09		-.09		.07		-.09		-.04		-.22**
Errors	.27**	.35***	.18**	.53**	.27**	.22**	-.01	-.10*	-.08	-.06	.51***	.05	-.03	-.06	.54***	-.08	-.34***	-.17**
Lapses		.24**		.34**		.27**		-.20**		-.25**		.09		-.22**		-.05		-.19**
Crash invol.	-.03	.00	.10**	.16**	.20**	.23**	-.02	-.22**	-.05	-.12*	.33***	.18**	-.02	-.13*	.34***	-.06	-.24**	-.01

N (GH = 478, UK = 404),
$^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$
Empty cells in table due to differences in factor structure of the DBQ between Ghana and UK

Appendix D, Table 2: Correlations among continuous scale scores (continued)

Source	Aggr.		Dislike		Hazard		Fatigue		Thrill		Distraction		Maint		Viol	Ord. viol.	Agg. viol	Errors		Lapses
	GH	UK	GH	UK	GH	UK	GH	UK	GH	UK	GH	UK	GH	UK	GH	UK	UK	GH	UK	UK
Aggression	1	1																		
Dislike	.63***	.54***	1	1																
Hazard Monitoring	-.12**	-.50***	-.22**	-.49***	1	1														
Fatigue	.60***	.57***	.61***	.57***	-.10*	-.50***	1	1												
Thrill	.56***	.64***	.64***	.46***	-.24**	-.69***	.65***	.59***	1	1										
Distraction	.63***	.19**	.64***	.11**	-.25**	-.03	.59***	.18**	.68***	.17**	1	1								
Maintenance	-.17**	.01	-.19**	-.16**	-.09*	.01*	-.22**	-.08	-.18**	.03	-.24**	-.09*	1	1						
Violations	.49***		.48***		-.17*		.53***		.46***		.53***		.37***							
Ord. viol		.29**		.20**		-.13**		.12**		.30***		.32***		.00		1				
Agg. viol		.20**		.13**		-.14**		.09		.19**		.22**		.04		.75***	1			
Errors	.42***	.09	.47***	.11**	-.11*	-.08	.50***	.19	.45***	.10**	.49***	.14**	.27**	-.07	.69***	.54***	.70***	1	1	
Lapses		.26**		.32***		-.26**		.23**		.26**		.20**		-.07		.65***	.65***		.68***	1
Crash invol.	.35***	-.00	.39***	.17**	-.13**	-.11*	.39***	.16*	.38***	.07	.36***	.07	.15**	-.06	.32**	.12**	.20**	.28**	.19**	.15**

N (GH = 478, UK = 404),
**p<.05, **p<.01, ***p<.001*
Empty cells in table due to differences in factor structure of the DBQ between Ghana and UK