

THE ROLE OF ATTITUDES TOWARD SAFETY IN DRIVING BEHAVIOUR: TESTING THE MEDIATION OF INTENTIONAL AND UNINTENTIONAL DRIVER ERRORS

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HIGHLIGHTS

- Safety attitudes showed indirect links between HEXACO traits and violations.
- Indirect effects emerged for emotionality, extraversion, and conscientiousness.
- Openness to experience also showed an indirect effect on violations.
- No indirect effects were found for mistakes, lapses, or inexperience.
- Intentional and unintentional behaviours may involve different mechanisms.

ABSTRACT

Background: The aim of the study was to examine whether attitudes toward safety are statistically associated with the relationship between HEXACO (honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, openness to experience) personality traits and Reason's classification of driving behaviours, and whether this pattern differs between intentional and unintentional behaviours. **Material and Methods:** The study involved 76 women and 122 men who drive passenger vehicles as part of their professional duties. The *HEXACO Personality Inventory-Revised* was used to measure personality traits, the *Driving Behaviour Questionnaire* to assess driving behaviours, the *Safety Attitudes Questionnaire* to measure attitudes toward safety, and a demographic survey. **Results:** Statistically significant indirect effects via attitudes toward safety were found between emotionality, extraversion, conscientiousness, and openness to experience and violations. For honesty-humility and agreeableness, both indirect effects via attitudes toward safety and direct effects on violations were observed. No significant indirect effects via attitudes toward safety were found for mistakes, lapses, or inexperience. **Conclusions:** The findings suggest that attitudes toward safety may be more closely related to intentional violations than to unintentional driving behaviours. At the same time, the absence of indirect effects for mistakes, lapses, and inexperience, together with the presence of some direct associations with HEXACO traits, suggests that additional cognitive or self-regulatory mechanisms may be involved. Given the cross-sectional design, the results should be interpreted as correlational and require further verification in longitudinal and multi-method research. *Med Pr Work Health.* 2026;77(6)

Key words: drivers, occupational safety, human factors, attitudes toward safety, driving behaviour, HEXACO personality model

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INTRODUCTION

In traffic psychology, personality traits are successfully measured as predictors of various driving behaviours [1–4]. Although different personality models are used [5,6], the HEXACO model (honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, openness to experience) [7], with the honesty-humility dimension, appears to have significant explanatory value [8]. Burtäverde et al. [8] compared the predictive validity of the HEXACO model with the Big Five Model [9] in explaining risky driving behaviours. The results demonstrated that the honesty-humility factor, which pertains to moral aspects of behaviour,

explains risky driving associated with various forms of aggression, both adaptive and maladaptive driving styles, and also predicts verbal aggression, speeding, risky driving, and cautious driving. The HEXACO model showed stronger predictive power for aggressive driving, while conscientiousness and agreeableness were negatively correlated with aggressive and maladaptive driving styles. In summary, the configuration of low honesty-humility, low conscientiousness, and low agreeableness promotes risky behaviours and the occurrence of traffic accidents [10].

The traits included in HEXACO model can be understood not merely as a set of statistical predictors but as distal dispositions that shape safety-relevant goals,

self-regulatory capacities, and adherence to social norms. These dispositions influence driving behaviour indirectly, through more proximal cognitive–motivational processes. Within this framework, attitudes toward safety reflect evaluative beliefs concerning traffic rules, responsibility for other road users, and the acceptability of risk-taking, and thus constitute a plausible proximal pathway linking personality traits to deliberate driving choices. This pathway is particularly relevant for behaviours involving a strong volitional component, such as traffic violations, in which drivers weigh competing demands including convenience, time pressure, perceived social norms, and the perceived legitimacy of traffic regulations [8].

The HEXACO dimensions can be mapped onto mechanisms that are theoretically more relevant to intentional vs. unintentional aberrant behaviours. Honesty-humility and agreeableness capture fairness, sincerity, and a non-exploitative interpersonal orientation, which should reduce the acceptance of rule breaking and increase willingness to comply with safety norms; therefore, their associations are expected to be most visible in intentional violations. Conscientiousness reflects impulse control, planning, and persistence, which may reduce deliberate violations (through stronger self-control and rule adherence) and may also relate to fewer errors by supporting sustained attention and careful execution of routines. Extraversion and openness to experience may be linked to reward sensitivity, stimulation seeking, and novelty orientation; these tendencies may manifest as violations mainly when safety attitudes are permissive or when rules are perceived as negotiable. Emotionality may relate to heightened threat sensitivity and worry, which can foster caution and pro-safety evaluations in some drivers, but may also be associated with distraction or stress-related attentional lapses in demanding conditions – making it less straightforward to predict for unintentional errors. Overall, this reasoning is consistent with dual-process and self-regulation perspectives: intentional violations are more likely to be guided by evaluative beliefs and goals, whereas unintentional errors may depend more strongly on momentary cognitive control and automaticity [3,6,8].

Reason's Generic Error Modelling System [11] is widely used in empirical research [12,13]. Focusing on cognitive factors as the primary cause of driver errors, it categorizes driving behaviours into: violations, errors, cognitive mistakes, and lapses [14]. The *Driving Behaviour Questionnaire* (DBQ) remains the most widely adapted tool for studying driving behaviours globally [15,16]. Although the factor structure of the DBQ varies by country and

study, authors typically report a 3- or 4-factor structure, in which driving behaviours are divided into intentional (violations) and unintentional (mistakes, lapses, and inexperience).

Reason [11] conceptualizes driver error categories functionally – based on outcomes and potential risks, rather than as homogeneous categories in terms of the underlying psychological processes. Thus, human errors encompass behaviours with different psychological foundation and varying degrees of intentionality. While violations result from conscious decision-making, mistakes and lapses stem from uncontrolled processes or cognitive deficits [17,18]. Recent studies indicate that the mechanisms underlying violations are more strongly associated with values, motivation, and intentionality, whereas other behaviours (mistakes, lapses, and inexperience) are better explained by cognitive factors such as impulsiveness, or self-control [16]. This distinction has important theoretical and practical implications, particularly in the context of identifying mediating mechanisms.

Understanding the mediating mechanisms between personality predispositions and behaviours enables a deeper understanding of the complexity of the relationship between individual traits and actual driving behaviour [19]. Special importance is attributed to the attitude toward safety, which reflects internal beliefs, norms, and values related to risk and responsibility [20,21]. The attitude toward safety is a situationally rooted construct that may mediate the relationship between permanent traits and specific behaviours. As emphasized by contemporary cognitive-affective models [22,23], attitudes are key determinants of behaviour, and their mediating role has been confirmed in numerous studies in the fields of health, organization, and safety [24–27].

Attitudes, as relatively stable beliefs, emotions, and behaviours toward specific categories of actions, are significant predictors of deliberate actions [22,23], but lose relevance in the case of unintentional actions. Therefore, incorporating attitudes toward safety as a mediator between personality and driving behaviour in Reason's model requires critical verification [11]. It seems reasonable to assume that attitude toward safety, as a motivational construct, plays a significant mediating role in behaviours that are consciously and intentionally undertaken, such as traffic violations. However, in the case of unintentional behaviours, the role of attitudes may be limited or insignificant, justifying the need to distinguish these categories also at the level of psychological mechanisms.

Recent research also indicates that professional drivers should not be treated as a homogeneous category. Occupational driving contexts differ in daily exposure, time pressure, fatigue, distraction, vehicle demands, and organisational safety conditions, which may shape both risky behaviour and its psychological correlates. For example, mixed-group studies of professional drivers have shown meaningful differences between freight and passenger transport contexts, while recent studies on taxi drivers, truck drivers, and last-mile delivery professionals point to elevated roles of distraction, safety climate, and work-related demands in explaining unsafe driving patterns. This broader evidence supports the rationale for studying occupational drivers as a distinct group and for interpreting the present findings specifically within the context of category B drivers who use passenger vehicles as part of their professional duties, rather than assuming straightforward generalization to all drivers or all professional transport sectors [28–31].

Building on the distinction between intentional and unintentional aberrant behaviours and on self-regulation/dual-process accounts, a model was tested in which attitudes toward safety represent a proximal correlate linking distal personality dispositions with driving behaviours. Specifically, it was examined whether attitudes toward safety statistically account for (i.e., are associated with) the relationships between HEXACO traits and intentional violations, and whether analogous indirect associations are present for unintentional errors (mistakes, lapses, and inexperience) [32]. Because unintentional errors may depend more strongly on momentary cognitive control and automaticity, any indirect associations via safety attitudes were expected to be weaker and less consistent for errors than for violations. Finally, the bivariate relationships between HEXACO traits and the 4 categories of driver behaviour were examined as a complementary description of the overall pattern of associations in this occupational sample [33].

MATERIAL AND METHODS

Participants were selected using purposive sampling and included only individuals who drive a passenger vehicle as part of their professional duties. Inclusion criteria were: holding a driving licence for ≥ 1 year and informed, voluntary consent to participate. The study was conducted February–April 2022 at an occupational medicine facility, following prior approval from the institution's authorities. The study adhered to ethical standards throughout its implementation. Participation was

voluntary, anonymous, and based on informed consent. No sensitive or health-related personal data were collected, and the questionnaire was non-invasive, posing no risk to participants. In line with institutional and national regulations, formal ethical approval was not required. The research was conducted in accordance with the principles of the Declaration of Helsinki. To reduce evaluation apprehension and social desirability, participation was anonymous and the study was explicitly described as non-evaluative, with no individual feedback and no occupational consequences.

Because the study relied on self-report questionnaires and data collection was conducted in a single session, temporal separation of predictor and outcome measurements was not possible. To reduce the risk of common method variance at the procedural level, several design features were implemented:

- spatial/psychological separation of constructs by placing the safety attitudes measure between personality (HEXACO) and driving behaviour (DBQ),
- a fixed order from more general dispositions to more behaviour-specific reports (HEXACO, followed by the safety attitudes measure, and finally the DBQ), to reduce priming and carryover effects,
- careful tool selection to avoid overlapping item content across constructs,
- anonymous, non-evaluative participation to reduce social desirability.

As a supplementary statistical diagnostic of common method variance, Harman's single-factor test was conducted on all study items. An unrotated exploratory factor analysis with one-factor extraction imposed showed that the first factor accounted for 22.8% of the total variance, which is below the conventional 50% threshold. This result suggests that common method variance is unlikely to account for the majority of covariance among the study measures. However, because Harman's test is only a rough diagnostic, it was treated as a supplementary rather than definitive assessment of method bias.

The data supporting the findings of this study are available in anonymized form on the Open Science Framework repository [34].

Tools

Demographic questionnaire

The demographic questionnaire included questions about participants' sociodemographic data and traffic incidents with their involvement. It allowed to collect information on gender, age, marital status, education

level, driving experience, and average monthly mileage. The last 2 indicators were intended as realistic measures of driving experience. The question about driving experience was clarified to reflect actual vehicle use, which may differ from the number of years holding a driving license. Additionally, participants were asked about any collisions or accidents (through their fault) and the number of traffic fines received in the past 2 years.

HEXACO Personality Inventory-Revised

Personality traits were measured using the *HEXACO Personality Inventory Revised* by Lee and Ashton [35], consisting of 100 items in the Polish adaptation [36]. The tool measures 6 main dimensions: honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, and openness to experience, along with 25 subscales [37]. Participants respond to the items on a 5-point Likert scale (from 1 – “strongly disagree” to 5 – “strongly agree”). The reliability of the tool, measured using Cronbach’s α in the present study, was satisfactory and equalled respectively for particular scales: honesty-humility – 0.81, emotionality – 0.74, extraversion – 0.77, agreeableness – 0.78, conscientiousness – 0.80, and openness to experience – 0.79. When presenting the analyses of the conducted studies, the authors decided to refer only to the main factors of the HEXACO model.

Driving Behavior Questionnaire

Driving behaviours were measured using the DBQ developed by Reason [20], in the Polish adaptation by Niezgoda, Kamiński, Kruszewski, and Tarnowski [38]. The questionnaire consists of 32 items related to driving behaviour. Participants responded on a 6-point Likert scale (from 0 – “it never happens to me” to 5 – “it very often happens to me”). Four subscales were distinguished in the Polish version: violations, mistakes, lapses and inexperience. The reliability of the tool, measured using Cronbach’s α in the present study, was satisfactory and equalled respectively for particular scales: violations – 0.83, mistakes – 0.81, lapses – 0.80, inexperience – 0.76.

Safety Attitudes Questionnaire

To measure attitudes toward safety, the *Safety Attitudes Questionnaire* developed by Znajmiecka-Sikora [39] was used. It consists of 18 statements rated on a 5-point Likert scale (from 1 – “strongly disagree” to 5 – “strongly agree”). The total individual score is the sum of all item scores – the higher scores, the more positive attitudes toward safety and greater engagement in safe behaviours.

The reliability of the tool, measured using Cronbach’s α in the present study, was satisfactory and equalled 0.80.

Sample characteristics

The study included 198 category B drivers who operate passenger vehicles as part of their professional duties: 76 women (38.4%) and 122 men (61.6%). Participants’ ages ranged 19–63 years (mean $\pm$ standard deviation [$M \pm SD$] 35 ± 6.4 years). Their sociodemographic characteristics are presented in Table 1. Driving experience ranged 1–41 years ($M \pm SD$ 4.8 ± 9.1 years). In the past 2 years, 70 participants had received ≥ 1 traffic fine. The average monthly mileage was 1733 km, with a min. of 40 km and a max of 10 000 km.

The sample consisted of professional drivers from various industries, which ensures variability in driving experience and behaviours. While the sample size is moderate, it is consistent with other studies using mediation models with multiple predictors [40]. Additionally, the use of bootstrapping increases the robustness of mediation analyses even in smaller samples. Partici-

Table 1. Sociodemographic characteristics and traffic fine history of drivers from the Kujawsko-Pomorskie Voivodeship, Poland, February–April 2022

Variable	Participants	
	n	%
Sociodemographic (N = 198)		
gender		
female	76	38.4
male	122	61.6
education		
primary	3	1.5
vocational	15	7.6
secondary	74	37.4
higher	106	53.5
marital status		
single	96	48.5
in a relationship	101	51.0
widowed	1	0.5
Traffic fines over the last 2 years (N = 70, 35.4%)		
1 fine	32	45.7
2 fines	22	31.5
3 fines	8	11.4
4 fines	5	7.1
5 fines	3	4.3

Table 2. Descriptive statistics and normality distribution (W Shapiro-Wilk) for the study variables among drivers (N = 198) from the Kujawsko-Pomorskie Voivodeship, Poland, February–April 2022

Variable	M	SD	Min.	Max	W Shapiro-Wilk	p	Skewness	Kurtosis
Honesty-humility	60.29	7.99	29.00	80.00	0.99	0.13	−0.24	0.68
Emotionality	45.88	8.26	26.00	71.00	0.96	<0.001	0.82	3.93
Extraversion	58.47	7.01	37.00	76.00	0.99	0.19	−0.30	0.27
Agreeableness	52.44	7.53	29.00	76.00	0.98	<0.01	−0.18	1.04
Conscientiousness	63.62	6.31	42.00	80.00	0.98	0.05	−0.05	0.50
Openness to experience	55.02	8.35	31.00	78.00	0.99	0.92	0.02	−0.07
Attitude toward safety	72.80	7.21	44.00	90.00	0.98	<0.01	−0.36	0.88
Violations	6.92	5.42	0.00	24.00	0.91	<0.001	1.06	0.73
Mistakes	1.86	2.47	0.00	13.00	0.76	<0.001	1.75	3.08
Lapses	3.87	3.76	0.00	23.00	0.86	<0.001	1.60	4.00
Inexperience	2.95	3.19	0.00	19.00	0.84	<0.001	1.59	3.49

pants were recruited using purposive sampling in an occupational medicine setting and included only drivers who operate passenger vehicles as part of their professional duties. Therefore, the results primarily generalize to similar occupational groups and may not directly extend to non-professional drivers or to professional drivers operating other vehicle categories. This issue is addressed explicitly in the limitations section.

RESULTS

Descriptive statistics

In the first step of the analyses, descriptive statistics and normality distributions of the studied variables were calculated to determine the appropriate statistical tests (Table 2).

Relationships between personality traits and driving behaviours

Next, the relationships between the HEXACO personality dimensions, attitudes toward safety, and driving behaviours were examined. The results are presented in Table 3.

The analysis of the relationships between the variables revealed statistically significant correlations between the dimensions of honesty-humility, agreeableness, and conscientiousness and all types of driving behaviours; emotionality and both lapses and inexperience; extraversion and lapses; openness to experience and both violations and mistakes; attitude toward safety and both violations and mistakes. Attitude toward safety was significantly associated with all HEXACO di-

mensions except emotionality. In terms of effect size, the strongest associations were observed between violations and other behaviour categories ($\rho = 0.48\text{--}0.60$) as well as between the unintentional behaviour categories ($\rho = 0.66\text{--}0.67$), indicating substantial overlap between self-reported driving behaviour dimensions. Associations between personality traits/safety attitudes and driving behaviours were generally small-to-moderate (e.g., $\rho = 0.10\text{--}0.44$), which is typical for individual-differences research in applied settings.

Attitudes toward safety as a statistical intermediary variable between personality and driving behaviours – hypotheses verification

In the following steps, mediation analyses were conducted for each type of driving behaviour. Mediation effects were tested using Hayes' PROCESS macro [40] implemented in IBM SPSS Statistics (IBM Corp., Armonk, NY, USA), with 5000 bootstrap samples. Given the cross-sectional design, the mediation models are interpreted as statistical representations of associations (i.e., indirect effects) consistent with the proposed framework rather than as evidence of causal mechanisms. Confidence intervals (95%) were adopted to assess the significance of the indirect effect [40]. In accordance with the theoretical model, a simple mediation model (Model 4) was used. The results for particular driving behaviours – violations, mistakes, lapses and inexperience are presented in Table 4.

Bootstrapped indirect effects (ab) indicated statistically significant indirect associations via attitudes toward safety for emotionality, extraversion, conscientiousness,

Table 3. Spearman's rank correlations among personality traits, attitude toward safety, and self-reported driving behaviours in a sample of drivers (N = 198) from the Kujawsko-Pomorskie Voivodeship, Poland, February–April 2022

Variable	Spearman's rank correlation										
	1	2	3	4	5	6	7	8	9	10	11
1. Honesty-humility	1										
2. Emotionality	−0.01	1									
3. Extraversion	0.25***	−0.05	1								
4. Agreeableness	0.39***	−0.24***	0.19**	1							
5. Conscientiousness	0.34***	0.01	0.26***	0.22**	1						
6. Openness to experience	0.19**	−0.03	0.26***	0.09	0.23**	1					
7. Attitude toward safety	0.38***	0.09	0.19**	0.22**	0.44***	0.20**	1				
8. Violations	−0.40***	0.04	−0.12	−0.36***	−0.25***	−0.15*	−0.29***	1			
9. Mistakes	−0.21**	0.11	−0.07	−0.21**	−0.26***	−0.14*	−0.17*	0.60***	1		
10. Lapses	−0.22**	0.22**	−0.16*	−0.26***	−0.23**	−0.13	−0.08	0.55***	0.67***	1	
11. Inexperience	−0.21**	0.14*	−0.12	−0.20**	−0.16*	−0.12	−0.09	0.48***	0.66***	0.66***	1

The results are significant for: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Spearman's ρ values around 0.10, 0.30, and 0.50 can be interpreted as small, moderate, and large associations, respectively.

and openness to experience, accompanied by non-significant direct effects (c'). For honesty-humility and agreeableness, both indirect effects and direct effects were statistically significant. These findings are consistent with the proposed conceptual model, but given the cross-sectional design they should not be interpreted as evidence of temporal or causal mediation.

For mistakes, the bootstrapped indirect effects via attitudes toward safety were not statistically different from 0, indicating no evidence of indirect associations through attitudes in this sample.

For lapses, the bootstrapped indirect effects via attitudes toward safety were not statistically different from 0.

For inexperience, the bootstrapped indirect effects via attitudes toward safety were not statistically different from 0.

DISCUSSION

The present study examined whether the pattern of associations between HEXACO personality traits and driving behaviours is consistent with attitudes toward safety functioning as a proximal attitudinal correlate of driver behaviour, and whether statistically significant indirect effects via attitudes differ between intentional (violations) and unintentional behaviours (mistakes, lapses, and inexperience). Using bootstrapped indirect effects, authors found evidence of indirect associations via safety attitudes for violations, whereas analogous indirect effects were not observed for unintentional behaviours. Because

the data are cross-sectional, these findings should be interpreted as correlational patterns consistent with the proposed framework rather than as evidence of causal mechanisms. From a practical perspective, even small-to-moderate associations may have meaningful implications in occupational driving, where many small risk contributions can accumulate across repeated exposure. Therefore, attitudes toward safety may be a feasible target for prevention aimed at reducing deliberate violations, even if personality-related effects are not large.

Consistent with the proposed framework, statistically significant indirect effects via safety attitudes were observed for violations. For emotionality, extraversion, conscientiousness, and openness to experience, the indirect effects were significant while the direct effects were not, whereas for honesty-humility and agreeableness both indirect and direct effects were significant. Interpreted cautiously, this pattern is consistent with the view that attitudes may be more proximal to deliberate, intentional behaviours than to behaviours that are rapid, automatic, or cognitively driven. However, causal conclusions cannot be drawn from the present cross-sectional data [24–26].

For honesty-humility and agreeableness, both the indirect effects via safety attitudes and the direct effects (c') were statistically significant, indicating that safety attitudes statistically account for part of the association while a residual direct association remains in this dataset. These individuals likely identify with social norms and transfer them to the domain of road safety.

Table 4. Mediation effects of attitude toward safety on the relationships between HEXACO (honesty-humility, emotionality, extraversion, agreeableness, conscientiousness, openness to experience) personality dimensions and driving behaviours (violations, mistakes, lapses, and inexperience) among drivers (N = 198) from the Kujawsko-Pomorskie Voivodeship, Poland, February–April 2022

HEXACO personality dimension	path a	p	path b	p	path c'	p	ab	95% CI	Mediation type
Violations									
honesty-humility	0.3805	<0.001	-0.1995	<0.001	-0.1917	<0.001	-0.0759	-0.1340–(-0.0267)	partial
emotionality	0.1533	0.013	-0.2897	<0.001	0.0031	0.944	-0.0444	-0.1003–(-0.0040)	full
extraversion	0.2079	0.004	-0.2914	<0.001	0.0121	0.817	-0.0606	-0.1105–(-0.0176)	full
agreeableness	0.2355	<0.001	-0.2397	<0.001	-0.1922	<0.001	-0.0565	-0.1102–(-0.0182)	partial
conscientiousness	0.5185	<0.001	-0.2488	<0.001	-0.1015	0.111	-0.129	-0.2131–(-0.0582)	full
openness to experience	0.176	0.004	-0.2836	<0.001	-0.0232	0.598	-0.0499	-0.0935–(-0.0157)	full
Mistakes									
honesty-humility	0.3805	<0.001	-0.0308	0.250	-0.0307	0.205	-0.0117	-0.0333–0.0096	no mediation
emotionality	0.1533	0.013	-0.0507	0.041	0.0277	0.199	-0.0078	-0.0201–0.0012	no mediation
extraversion	0.2079	0.004	-0.0430	0.085	-0.0109	0.672	-0.0089	-0.0262–0.0034	no mediation
agreeableness	0.2355	<0.001	-0.0361	0.150	-0.0351	0.144	-0.0085	-0.0238–0.0054	no mediation
conscientiousness	0.5185	<0.001	-0.0072	0.786	-0.0956	0.002	-0.0037	-0.0335–0.0250	no mediation
openness to experience	0.1760	0.004	-0.0369	0.137	-0.0350	0.102	-0.0065	-0.0206–0.0036	no mediation
Lapses									
honesty-humility	0.3805	<0.001	-0.0037	0.928	-0.0872	0.018	-0.0014	-0.0302–0.0304	no mediation
emotionality	0.1533	0.013	-0.0674	0.067	0.1146	<0.001	-0.0103	-0.0269–0.0022	no mediation
extraversion	0.2079	0.004	-0.0306	0.417	-0.0702	0.072	-0.0064	-0.0272–0.0094	no mediation
agreeableness	0.2355	<0.001	-0.0194	0.606	-0.0972	0.008	-0.0046	-0.0227–0.0159	no mediation
conscientiousness	0.5185	<0.001	0.0195	0.636	-0.1604	<0.001	0.0099	-0.0301–0.0509	no mediation
openness to experience	0.1760	0.004	-0.0308	0.415	-0.0577	0.078	-0.0054	-0.0230–0.0084	no mediation
Inexperience									
honesty-humility	0.3805	<0.001	-0.0309	0.369	-0.0582	0.062	-0.0117	-0.0388–0.0160	no mediation
emotionality	0.1533	0.013	-0.0693	0.029	0.0558	0.044	-0.0206	-0.0265–0.0006	no mediation
extraversion	0.2079	0.004	-0.0490	0.126	-0.0459	0.164	-0.0102	-0.0290–0.0031	no mediation
agreeableness	0.2355	<0.001	-0.0397	0.216	-0.0717	0.202	-0.0093	-0.0255–0.0070	no mediation
conscientiousness	0.5185	<0.001	-0.0254	0.467	-0.0824	0.040	-0.0132	-0.0486–0.0206	no mediation
openness to experience	0.1760	0.004	-0.0520	0.106	-0.0256	0.355	-0.0092	-0.0266–0.0018	no mediation

ab – indirect effect, CI – confidence interval, M – attitude toward safety (mediator), path a – effect of X on M, path b – effect of M on Y controlling for X, path c' – direct effect of X on Y controlling for M, X – HEXACO personality dimension (independent variable), Y – driving behaviour outcome (violations, mistakes, lapses, or inexperience).

The labels “full” and “partial” describe the statistical pattern of significant indirect effects with non-significant vs. significant direct effects in cross-sectional data and do not imply causality.

For extraversion and emotionality, the indirect effects via safety attitudes were statistically significant while the direct effects (c') were not, which is consistent with attitudes being a more proximal correlate of violations for these traits in this sample. This is particularly interesting, as it suggests that individuals with high extraversion and emotionality are not more likely to break rules unless they exhibit less safe attitudes. This finding suggests that attitudes can be a point of intervention even for traits that are less obviously linked to risky behaviours. Conscientiousness and openness to experience are also related to violations through the attitude toward safety. The result for conscientiousness aligns with previous studies suggesting that conscientious individuals are characterized by greater responsibility, self-discipline, and obedience to social norms.

At the same time, it is worth noting that traits alone are not always sufficient to inhibit risky behaviours. Only when combined with a positive attitude toward safety – manifested, e.g., in treating traffic regulations as an expression of concern for other road users – do they gain greater practical significance. On the other hand, openness to experience, which is mainly associated with reflectiveness and cognitive curiosity, also reflects a need for novelty or a tendency to explore unfamiliar situations, which may increase the willingness to experiment on the road. Therefore, open individuals who have not internalized safety principles may be more likely to engage in behaviours that deviate from established norms. Conversely, individuals high in openness and with a positive attitude toward safety may be more inclined to adopt innovative and thoughtful protective strategies – such as seeking information, using driver-assistance technologies, or avoiding driving in difficult conditions.

Some personality traits – primarily conscientiousness, honesty-humility, and agreeableness – showed negative correlations not only with violations but also with mistakes and lapses. This may indicate that certain personality characteristics support not only the conscious avoidance of risk but also promote a generally more attentive, cautious and organized behaviour style. However, these relationships were not mediated by the attitude toward safety, which may suggest the existence of other mediators, such as self-regulatory mechanisms or cognitive abilities. It may be worth considering the inclusion of variables such as self-regulation, executive functions, vigilance, resistance to distractors or impulse control. Identifying such mechanisms should be a direction for future research.

It is worthwhile to note the lack of indirect effects via attitudes toward safety in the relationships between personality traits and unintentional driving errors. This pattern is consistent with the possibility that unintentional behaviours are less strongly governed by evaluative beliefs and more strongly shaped by momentary cognitive functioning during driving. In occupational driving, such behaviours may arise under conditions of working-memory load, divided attention, distraction, fatigue, routine pressure, or automatic responding. Under these conditions, even drivers who endorse relatively positive safety attitudes may still commit lapses or mistakes, because the relevant mechanism is not primarily motivational but cognitive-regulatory. This interpretation is consistent with dual-process perspectives [41], according to which unintentional driver errors may depend more strongly on automatic and attention-related processes than on declared attitudes or safety-oriented intentions. At the same time, because cognitive and executive-function variables were not directly assessed in the present study, these explanations should be treated as theoretically informed interpretations rather than empirical conclusions drawn directly from the study data.

The absence of indirect effects via attitudes for unintentional behaviours suggests that Reason's behavioural distinction between intentional and unintentional categories may not fully capture differences in underlying psychological processes. Future research could refine this distinction by directly measuring cognitive-control and self-regulatory constructs alongside motivational attitudes.

Educational and preventive efforts aimed at drivers who intentionally violate traffic regulations should focus on changing beliefs, norms, and values related to road safety. Such programmes should not rely solely on the transmission of information but should primarily include components that modify attitudes – e.g., reflective exercises, group discussions, simulations of moral traffic dilemmas, or narrative messages. Interventions aimed at increasing the sense of responsibility for other road users (e.g., passengers, pedestrians) may effectively reduce the tendency to commit violations, particularly among individuals with lower levels of honesty-humility or conscientiousness.

From an occupational medicine and workplace-safety perspective, the present findings support a differentiated approach to prevention, recruitment, and driver training. In recruitment or periodic occupational assessment, personality traits should not be treated as stand-alone exclu-

sion criteria; however, personality and attitude profiles may help identify drivers who could benefit from additional preventive support. In training practice, interventions targeting intentional violations may benefit from attitude-focused components, such as norm clarification, reflective discussion of responsibility toward other road users, and exercises addressing the perceived legitimacy of traffic rules. At the same time, the present findings do not support the assumption that attitude modification alone will substantially reduce unintentional mistakes, lapses, or inexperience-related behaviours. For these outcomes, occupational prevention may need to place greater emphasis on fatigue management, distraction reduction, attention management, and self-regulatory skills.

The findings suggest that interventions focused solely on attitude modification may be less effective for unintentional behaviours; therefore, they may need to be complemented by components targeting attention and self-regulatory skills (e.g., attention/divided-attention training, fatigue awareness). Because cognitive competencies were not directly measured in this study, these recommendations are interpretative and should be evaluated in future multi-method research.

CONCLUSIONS

The present findings suggest that attitudes toward safety are a proximal correlate of intentional traffic violations and statistically account for part of the associations between several HEXACO traits and violations in this occupational sample (i.e., significant indirect effects were observed). In contrast, no indirect effects via attitudes emerged for mistakes, lapses, or inexperience, which is consistent with the idea that unintentional errors may depend more strongly on cognitive and self-regulatory factors not directly measured in the present study. Given the cross-sectional design and self-report measures, the results should be interpreted as correlational and require replication in longitudinal and multi-method research. Importantly, cognitive mechanisms underlying unintentional errors were not directly measured and should be examined in future multi-method and longitudinal studies.

Limitations and future directions

Several limitations should be acknowledged. First, the study relied on a purposive occupational sample of professional drivers recruited in an occupational medicine setting. This increases relevance for workplace safety, but it limits generalizability to non-profes-

sional drivers and to other driver populations (e.g., different vehicle categories or work contexts). Replication in broader community samples and across occupational driving settings is warranted.

Second, the sample size was moderate for a multiple-predictor mediation framework. While bootstrapping provides more robust estimation of indirect effects, the present findings should be interpreted as preliminary and in need of replication in larger samples. In addition, although key demographic indicators (e.g., age, driving experience, mileage) were collected and described, they were not modelled as covariates in the current analyses. These factors may contribute to heterogeneity in driving behaviour and should be incorporated in future research designs. Some potentially important individual factors (e.g., parenthood, detailed work schedules, fatigue/sleep quality) were not measured and should be considered in subsequent studies.

Third, all key constructs were assessed using self-report questionnaires administered within the same measurement context, which may increase the risk of social desirability, recall bias, and common method variance, potentially inflating associations. Although procedural remedies were applied (psychological separation of measures, ordering from general to specific, and anonymous non-evaluative participation), future research should use multi-method designs (e.g., objective indicators such as telematics or recorded infractions/collision data, multi-source ratings, or longitudinal measurement) to further reduce method-related bias. In addition, although a supplementary Harman's single-factor test did not indicate a dominant common factor, this procedure has recognized limitations and cannot conclusively exclude common method bias.

A related concern is social desirability bias, which may be particularly salient in a sample of professional drivers. Because safe driving is both socially valued and occupationally relevant, some participants may have been motivated to underreport violations, mistakes, lapses, or other unsafe behaviours and to present themselves as more safety-oriented than they actually are. Although anonymity and the explicitly non-evaluative character of the study were intended to reduce this tendency, socially desirable responding cannot be ruled out. This may have attenuated the reported frequency of aberrant driving behaviours and may also have affected the reliability of self-reported DBQ scores.

Although unintentional behaviours may be more dependent on cognitive control and automaticity, no cognitive measures were included in the present study;

therefore, statements regarding attentional or executive mechanisms are interpretative. Future research should directly assess these constructs using established tools, e.g.: measures of sustained attention/vigilance (e.g., *Continuous Performance Test* or *Psychomotor Vigilance Task*), inhibitory control (e.g., *Go/No-Go Task* or *Stop-Signal Task*), interference control (e.g., *Stroop Color and Word Test*), and set-shifting/processing speed (e.g., *Trail Making Test*). Where feasible, combining cognitive testing with driving-related performance indicators (e.g., simulator tasks, eye-tracking, or telematics-derived metrics) would provide a stronger test of mechanisms underlying unintentional errors.

AUTHOR CONTRIBUTIONS

Research concept: Patrycja Basińska

Research methodology: Patrycja Basińska

Collecting material: Patrycja Basińska

Statistical analysis: Patrycja Basińska

Interpretation of results: Patrycja Basińska, Aleksandra Błachnio

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