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A matter of style? Testing the moderating effect of driving styles on the relationship between job strain and work-related crashes of professional drivers

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ABSTRACT

Different empirical studies suggest that both job strain and driving styles are significant contributors to the work-related traffic crashes suffered by professional drivers. Nevertheless, the current evidence falls considerably short when explaining why driving styles may modify (or not) the relationship between occupational stressors and professional drivers' safety outcomes. The aim of this study was to examine whether driving styles moderate the effect of job strain on professional drivers' Work Traffic Crashes (WTCs). This research was performed using the data collected from a sample of 753 professional drivers, responding to a self-report questionnaire on job strain (work stress indicator of the Job Demand-Control model), driving styles and work-traffic safety outcomes suffered in the past two years. Regression-based moderation analyses suggest that the job strain of professional drivers is positively associated with the occupational traffic crashes they suffer, and that such association is stronger in drivers with "reckless & careless", "anxious", and "angry & hostile" driving styles. Meanwhile, the "patient & careful" (positive) driving style was not associated with a lower risk of suffering a WTC, nor with a lower vulnerability to stress-related WTCs. The results of this study support the hypothesis that driving styles exert a statistical moderation between the job strain and the occupational traffic crashes suffered by professional drivers. These findings may support the design of evidence-based interventions in both the organizational and individual levels, focused stress-related factors and driving styles as predictors of work traffic crashes.
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1. Introduction

Motor vehicle crashes are the leading cause of work-related deaths both in the U.S. (Bureau of Labor Statistics –BOL, 2018) and the European Union (European statistics on crashes at work –ESAW, 2018). Furthermore, about one third of the world's total traffic crashes involve professional drivers (Llamazares, Useche, Montoro, & Alonso, 2019; European Agency for Safety and Health at Work, 2018). In the transportation industry, most road fatalities due to traffic crashes involve heavy vehicles

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(semi, tractor-trailer and tanker trucks; BOL, 2018). However, in recent years, passenger transporters, such as taxi and bus drivers, have attracted the attention of numerous investigations on road safety and occupational health, due to their high exposure to psychosocial risk factors at work (e.g. high demands, low perception of task-control and social support, effort/reward imbalance) and the association of these factors with negative road safety outcomes (Gómez, Cendales, Useche, & Bocarejo, 2018; Useche, Gómez, & Cendales, 2017; Useche, Cendales, Montoro, & Esteban, 2018).

According to Matthews et al. (1998), stress is linked to road safety outcomes through three mechanisms related to driving performance: impaired psychomotor control and attention, poor hazard detection, and a high risk-taking. Regarding professional drivers, it has been documented that taxi and bus drivers report stressful working conditions, related to extensive workdays (Santos & Lu, 2016), shift work (Costa, 2010; Hege et al., 2015), traffic congestion (Evans & Carrère, 1991) and negative interactions with passengers (Havârneanu, Măirean, & Popuşoi, 2019). In addition, several studies performed on occupational groups of professional drivers suggest that psychosocial work stressors are associated with a higher risk of work-related traffic crashes, or *WTCs* (Gómez et al., 2018), traffic penalties (Montoro, Useche, Alonso, & Cendales, 2018) and risky driving (Useche et al., 2017).

1.1. Work stressors and driving styles among professional drivers

Recent evidence suggests that professional drivers' work stress is associated with driving styles (Useche, Cendales, Alonso, Pastor, & Montoro, 2019). According to Taubman-Ben-Ari, Mikulincer, and Gillath (2004), "driving styles" are sets of individual traits that characterize the way people usually drive, including dimensions related to their driving performance, such as attention and caution, average speed, emotions and behaviors while driving, in addition to attitudes, beliefs and values held towards road safety (Li, Oviedo-Trespalacios, Rakotonirainy, & Yan, 2018). Among human factors, which represent the main cause of traffic crashes in the general population (Evans, 1996; Petridou & Moustaki, 2000), driving styles stand out because of their consistency as predictors of risky driving behaviors and road crashes (Taubman-Ben-Ari & Skvirsky, 2016).

Useche et al. (2019) characterize professional drivers by using a four-dimensional model of driving styles, following the original approach provided by Taubman-Ben-Ari and Skvirsky (2016): (*a*) the reckless and careless driving style implies premeditated and repeated violation of transit laws; (*b*) the *anxious* driving style implies recurring feelings of anxiety, fear and discomfort while driving; (*c*) the *angry & hostile* driving style is characterized by the expression of hostility and aggressive behavior towards other drivers; and (*d*) the *patient & careful* driving style, which implies adherence to traffic rules, civility and politeness in the interactions with other road users. Abundant evidence suggests that reckless, anxious and angry driving styles are consistently associated with traffic crashes in the general population (Taubman-Ben-Ari & Skvirsky, 2016), and with WTC in the occupational group of professional drivers (Useche et al., 2019). Meanwhile, the careful-patient style is known to be a protective factor against road crashes (Taubman-Ben-Ari & Skvirsky, 2016).

In the particular case of Bogotá, previous studies have documented the typically adverse working conditions that public transport drivers face on a daily basis, characterized by (e.g.) long working hours, irregular shifts and shift-work (Gómez et al., 2018), and substantial shortcomings in terms of mobility efficiency, road infrastructure, built environment and security (Guzmán & Bocarejo, 2017; Guzmán, Oviedo, & Cardona, 2018), factors that, at the same time, may contribute to eliciting negative outcomes such as job strain, fatigue and risky road behaviors (Useche et al., 2017).

1.2. The interaction between work stress and individual factors: ¿who is at greater risk?

This study focuses on the interaction between working conditions and driving styles, which are safety-related individual traits. Some studies have investigated the effect of the interaction between work stress and individual factors, such as personality, on occupational safety and health outcomes (Grant & Langan-Fox, 2007; Spector & Jex, 1998; Useche et al., 2018). However, very few have specifically focused on the transportation industry. Most of the available evidence is based on moderation hypotheses, which suggest that idiosyncratic patterns of coping and reactivity produce individual differences in the stress related outcomes (Kammeyer-Mueller, Judge, & Scott, 2009; Parkes, 1994). From a cognitive approach (Lazarus, 2006), stress begins with an appraisal process, in which the individual determines whether or not the environmental demands threaten personally relevant resources, goals or values. When the primary appraisal process detects threats, coping processes are activated, focused on selecting and executing situationally appropriate emotional and behavioral responses. Thus, the moderating effect of personality in the association between stress and outcomes is due to differential traits in the individual importance attributed to the goals and values involved in the primary appraisal, and to differential predisposition to react both emotionally and behaviorally to stress.

For instance, in the field of occupational safety and health, individual traits such as high neuroticism have been found to exacerbate the effect of work-related stress on self-reported health problems (Grant & Langan-Fox, 2007), work inactivity (Batista & Reio, 2019) and alcohol consumption (Liu, Wang, Zhan, & Shi, 2009). Likewise, the associations of work stress with counterproductive work behaviors (Bowling & Eschleman, 2010) and emotional exhaustion (Houkes, Janssen, de Jonge, & Bakker, 2003) are stronger at high levels of negative affectivity; and the effects of work stress on safe behaviors (Chu, Guo, Liu, & Chen, 2019), well-being (Dijkstra, van Dierendonck, Evers, & De Dreu, 2005) and counterproductive work behaviors (Batista & Reio, 2019) are weaker at high levels of conscientiousness, extraversion and agreeableness.

In general, these associations patterns exist because people with stable individual traits that imply predisposition to negative experiences (e.g. neuroticism and negative affectivity) tend to believe that their personal coping mechanisms are

insufficient to meet the quantitative work demands (Kammeyer-Mueller et al., 2009). Therefore, they are more vulnerable to stress and more likely to react negatively to stressors (physically, emotionally and behaviorally). Meanwhile, positive personality (e.g. self-awareness and agreeableness), which involves traits such as optimism, enthusiasm, assertiveness, planning and problem-solving orientation, usually gives people access to more resources to cope with work demands, in addition to allowing for a more effective use of these resources. Therefore, employees with positive personality traits are less vulnerable to stress and stress-related reactions (Hobfoll, 1989; Kammeyer-Mueller et al., 2009).

To date, there is no research about the moderator effect of driving styles on the association between work stress and safety outcomes. Therefore, this study adds up to, and differs from, previous literature examining whether driving styles modify (i.e. moderate) the association between work stress and WTC among professional drivers. Unlike the general personality (e.g. the big-5 typology), driving styles are more specific individual traits, related to the drivers' predisposition to perceive and react to road situations in an idiosyncratic way. Therefore, the evidence collected by this research can be particularly useful for improving the selection processes of professional drivers (e.g. applicants with maladaptive driving styles are not good candidates for becoming professional drivers, due to their propensity to stress-related accidents), as well as for the design of occupational safety and health interventions, tailored to the drivers' specific risk profile.

1.3. The current study

The core aim of this study was to examine whether driving styles modify (i.e. moderate) the effect of work stress on professional drivers' work traffic crashes. According to the job demand-control or JDC model of stress (Karasek, 1979), quantitative job demands and decision latitude (i.e. the sum of skill discretions and decision authority at work) are working conditions that influence the workers' health and organizational behavior both jointly and separately. According to the JDC model, the concept of "job strain" (that, in the literature, is commonly addressed as an equivalent of job stress) can be understood as the problematic interaction between high demands and low decision latitude (or *control*), implying potential adverse health, performance and safety outcomes for workers (Heikkilä, K., Fransson, E. I., Nyberg, S. T., Zins, M., Westerlund, H., Westerholm, P., . . ., Work Consortium (2013) (2013) (2013), 2013; Ota, Yatsuya, Mase, & Ono, 2015). Also, the link between job strain and negative safety outcomes is due to the fact that the concentration of personal resources in coping with stress prevents workers from focusing their efforts and skills on the careful execution of tasks, and on the compliance of safety procedures (Spector & Jex, 1998; Turner, Stride, Carter, McCaughey, & Carroll, 2012). Likewise, the stress-related experience of resource depletion limits the physical and cognitive performance, as well as the emotional control, thus predisposing drivers to counterproductive work behaviors. Specifically in the field of driving, it is known that stress is associated with impaired psychomotor control, poor hazard detection, increased risk-taking (Martí-Belda, Pastor, Montoro, Bosó, & Roca, 2019; Matthews et al., 1998) and increased risk of suffering crashes (Gómez et al., 2018). Therefore, this study predicts that (H1) *job strain is positively associated with WTC.*

Regarding driving styles, abundant evidence suggests that maladaptive driving directly increases the risk of traffic crashes; while adaptive styles have the opposite effect (for a summary, see Taubman-Ben-Ari & Skvirsky, 2016). However, the driving styles model also suggests that there may be differential patterns of response to driving stressors, depending on the drivers' profile. To this extent, there are theoretical arguments hypothesizing an interactive effect of job strain and driving styles on the drivers' safety outcomes.

For instance, in aggressive drivers, the appraisal of traffic situations usually involves aversive cognitions (e.g. catastrophizing, overgeneralizing, inflammatory labeling, images and thoughts of revenge, hostile attributional bias, and aggression-supportive beliefs), which in turn involve high stress reactivity and risky driving behaviors, associated with the aversive use of the vehicle as a mechanism of emotional expression (Deffenbacher, 2016; Taubman-Ben-Ari & Skvirsky, 2016). Therefore, it can be predicted that (H2) *the association between job strain and work traffic crashes is stronger in professional drivers with (highly) angry and hostile driving styles.*

Moreover, high trait anxiety is associated with physiological hyper-responsiveness to stress (Weger & Sandi, 2018), exaggerated defensive engagement despite coping availability (Sege, Bradley, & Lang, 2018), attentional biases (Bishop, 2007; Weger & Sandi, 2018) and poor task performance under stress conditions (Goette, Bendahan, Thoresen, Hollis, & Sandi, 2015). These findings suggest that (H3) t*he association between job strain and work traffic crashes is stronger in professional drivers with (highly) anxious driving style.*

Reckless and careless driving style is associated with individual traits such as sensation seeking and impulsivity (Taubman-Ben-Ari & Skvirsky, 2016), which may involve higher risk-taking in order to overcome potentially stressful situations (e.g. running a red light or not yielding to pedestrians as a response to time pressure). In addition, as sensation seekers, professional drivers with reckless and careless driving style can easily get bored in low-stimulating situations (Hoyle, Stephenson, Palmgreen, Lorch, & Donohew, 2002), typical of heavy traffic in big cities (e.g. traffic jams), and may also have problems when coping with boredom (Dahlen, Martin, Ragan & Kuhlman, 2005). It is known that workers perceive tedious or repetitive work as stressful, and "boredom stress" is associated with both counterproductive work behaviors (Bruursema, Kessler, & Spector, 2011; Spector et al., 2006) and unsafe behaviors, such as increased risk-taking or unsafe practices in order to cope with boredom (Game, 2007). In line with these findings, this study predicts that (H4) *the association between job strain and work traffic crashes will be stronger in professional drivers with (highly) reckless and careless driving styles.*

On the other hand, a patient and careful driving style is associated with prosocial driving and with the recurrent use of specific driving strategies focused on managing stress and emotions (e.g. managing breathing, counting to 10, planning trips)

(Taubman-Ben-Ari & Skvirsky, 2016). This driving style is also characterized by a commitment to road safety and respect for traffic regulations. In addition, the patient and careful driving style is negatively associated with personality traits that imply a higher vulnerability to stress, such as neuroticism and trait anxiety (Taubman-Ben-Ari et al., 2004); and it is also positively associated with personality traits that increase resistance to stress, such as agreeableness and conscientiousness (Taubman-Ben-Ari & Yehiel, 2012). Therefore, this study finally predicts that (H5) *the association between job strain and work traffic crashes will be weaker in professional drivers with (highly) patient and careful driving styles.*

2. Methods

2.1. Participants

For this study, a convenience sample of 753 professional drivers (98.4% men) from 5 Transport companies in the city of Bogotá (Colombia) was gathered. Regarding vehicle types, 56.3% of the participants are urban bus drivers, 18% are inter-urban bus drivers and 25.7% are taxi drivers. Most of the professional drivers in the sample are full-time employees (90.2%, the remaining percentage works less than 40 h a week). The average age of the participants was 41 (SD = 11.2) years old, and the average time of employment in their current job was 8 (SD = 5.8) years.

2.2. Description of the questionnaire

Work stressors were self-reported by participants using the scales of psychological demands (5 items, range 12–48, $\alpha = 0.63$; *example of item: "I have to respond to contradictory orders*"), skill discretion (6 items, range 12–48, $\alpha = 0.75$; *example of item: "I have the opportunity to develop my own skills*") and decision authority (3 items, range 12–48, $\alpha = 0.69$; *example of item: "I am given a lot of freedom to decide how I do my own work*") from the Job Content Questionnaire –JCQ (Karasek et al., 1998), validated in Colombia by Gómez (2011). For each item in the questionnaire, participants were asked to choose the option that best described their work situation on a Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). Decision latitude was calculated as the sum of skill discretion and decision authority. In accordance with what is suggested by both the JCQ Center (Cedillo & Karasek, 2003) and the validated version of the JCQ that we used for this study (Colombian version; Gómez, 2011), the Job Strain score was calculated through the equation: JS= ((Demands*2) / Decision latitude or *Control*). The JCQ measures objective characteristics of work organization, usually stable in nature (Karasek et al., 1998). As participants had not experienced recent changes in their working conditions, and the JCQ has adequate long term test–retest reliability (d'Errico, Punnett, Gold, & Gore, 2008), it was assumed that the drivers' job strain scores cover a time window of at least two years, which is the minimum time of employment in their current company.

Driving styles were measured using the version of the Multidimensional Driving Style Inventory – MDSI (Taubman-Ben-Ari et al., 2004) validated for professional drivers by Useche et al. (2019). This version of the questionnaire has a factorial structure that differentiates four sub-scales or driving styles: Reckless & Careless (11 items, $\alpha = 0.77$); Anxious (12 items, $\alpha = 0.82$); Angry & Hostile (4 items, $\alpha = 0.70$); and Patient & Careful (6 items, $\alpha = 0.75$). The MDSI items are answered through a five-point Likert scale, in which the driver reports to what extent he/she identifies (1 = not at all, 2 = not much, 3 = a little bit, 4 = a lot, 5 = very much) with a set of situations and behaviors typical of motor vehicle driving. The scores of each driving style were calculated by averaging the corresponding subscale items (for additional information on the psychometric characteristics of MDSI in this same sample, see Useche et al., 2019).

Finally, the questionnaire included a section of demographic data (e.g., gender, age, educational level), job-related features (type of vehicle driven at work, hours driving / day, days driving / week, shift-working, job type and seniority) and self-reported Work Traffic Crashes (WTCs) suffered during the past two years (i.e. "*regardless of their severity, how many driving crashes have you suffered (strictly) while working during the last 2 years?*").

2.3. Procedure and statistical analysis

Data collection was carried out using paper printed questionnaires, which were filled out by professional drivers during their rest periods at the facilities of the transport companies that agreed to participate in the study. Two members of the research team accompanied the participants during the data collection process. Before answering the questionnaire, the participants signed an informed consent form.

The study hypotheses were tested using moderation analysis, form a hierarchical linear regression approach (Baron & Kenny, 1986). In total, four regression models (one for each moderation hypothesis), with the number of crashes in the last two years as criterion variable, were used. In step 1 of the regressions, covariates (age, sex, shift work and seniority in the company) were included. In step 2, job strain and the driving style corresponding to each hypothesis were introduced (both variables were previously standardized). Finally, in step 3, the multiplicative interaction between the predictors included in step 2 of the model (job strain*driving style) was introduced. One regression model was used for each hypothesis, instead of a single model with all the interaction terms. This was done because driving styles are highly intercorrelated (see Table 1), which produces altered coefficients due to multicollinearity problems. The significant interactions were analyzed using simple slope tests and the graphic method by Aiken & West (1991), which consists of mapping the predicted values of

Table 1
Descriptive statistics of the study variables and bivariate correlations.

Study variable	Mean	SD	Min.	Max.	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Gender (% male)[a]	98.4%[c]	–	–	–	0.027	0.018	0.009	−0.012	0.108**	0.061	0.089*	−0.052	−0.200**	−0.259**	−0.112**	0.096**	−0.105**
2. Shift work (% yes)[b]	22.4%[c]	–	–	–	–	0.049	0.047	0.050	0.059	0.073	0.076*	−0.008	−0.013	−0.041	−0.011	0.035	−0.047
3. Age	41.14	11.17	18	76		–	0.448**	−0.147**	0.013	0.041	0.030	−0.101**	−0.226**	−0.143**	−0.235**	0.012	−0.114**
4. Seniority (tenure)	7.96	7.64	2	23			–	−0.015	−0.053	−0.008	−0.032	0.027	−0.040	0.028	−0.060	−0.078*	0.009
5. Demands	32.21	7.42	12	48				–	0.017	−0.014	0.000	0.703**	0.262**	0.199**	0.258**	−0.012	0.112**
6. Skill discretion	36.76	5.25	14	48					–	0.585**	0.832**	−0.544**	−0.128**	−0.145**	−0.103**	0.094*	−0.215**
7. Decision authority	39.29	8.34	12	48						–	0.937**	−0.611**	−0.086*	−0.142**	−0.067	0.109**	−0.161**
8. Decision latitude	76.04	12.16	26	96							–	−0.653**	−0.113**	−0.158**	−0.091*	0.116**	−0.203**
9. Job strain	0.88	0.28	0.27	3								–	0.222**	0.212**	0.210**	−0.077*	0.235**
10. Reckless & Careless style	1.78	0.50	1	3.64									–	0.723**	0.673**	−0.044	0.228**
11. Anxious Style	1.62	0.52	1	3.92										–	0.605**	−0.104**	0.255**
12. Angry & hostile style	1.94	0.71	1	4.25											–	−0.032	0.151**
13. Patient careful style	3.44	0.58	1	5												–	−0.080*
14 WTC (2 years)	0.50	1.03	0	11													–

Notes:
[a] Categorical dichotomous variable (values are computed as 1 = male; 0 = female).
[b] Categorical dichotomous variable (values are computed as 1 = performs shift-work; 0 = does not perform shift-work).
[c] Percentage (used for categorical variables instead of arithmetic means).
** Significant at level p < .001 (two-tailed).
* Significant at level p < .05 (two-tailed).

the criterion variable by entering extreme values (positive = +1 SD and negative = −1SD) of the independent and moderator variables in the linear equation.

2.4. Ethics

This research was framed within the macro-project entitled "*Training, Occupational Psychosocial Factors, Health and Safety of Professional Drivers*" (IRB number H1517828884105 - Ethics Committee of the University of Valencia), which was certified to comply with the general ethical principles relevant to research in Social Sciences, and to the Declaration of Helsinki.

3. Results

Table 1 summarizes the descriptive statistics of the study variables. Overall, the mean score for decision latitude or control (M = 76.04) was higher if compared to a previous application of the JCQ among Colombian professional drivers (M = 55.90; Gómez, 2011), while the average value of psychological demands (M = 32.21) was similar (M = 32.60; Gómez, 2011). Given that the JS score is based on the ratio between demands and control, the average score of job strain (M = 0.88) was below the 1.0 risk threshold (see *Description of the Questionnaire* for guidance). Regarding driving styles, the highest average was for the patient & careful style, followed by the angry & hostile, reckless & careless and anxious driving styles. As it was expected, WTC's associations with psychological demands, job strain and maladaptive driving styles (angry & hostile, reckless & careless and anxious styles) were positive. On the other hand, WTC were negatively associated with decision latitude and with the patient & careful driving style.

Table 2 summarizes the results of the hierarchical linear regression models used to predict WTC, based on job strain and driving styles. In conjunction, all predictors included in the models explained significantly between 8% and 17% of the WTC variance. Consistent with hypothesis 1, job strain was significantly positively associated with WTCs, and was also the predictor which displayed the greatest weight in all regression models. The Reckless & Careless and Anxious styles (models 1 and 2, respectively) were significantly associated with WTCs, but the Angry & hostile and Patient & careful ones were not (models 3 and 4, respectively). Regarding the moderation hypotheses, significant interactions were found between job strain and Reckless & Careless style, job strain and Anxious style, and between job strain and Angry & hostile style.

Figs. 1–3 decompose the interaction effects found in the regression models. According to hypotheses 2, 3 and 4, respectively, it was found that the association between work strain and WTC is significantly stronger when there are high levels of

Table 2
Hierarchical regression models predicting WTC based on job strain, driving styles and their interaction.

Predictors	B	E	Beta	t	*p*	95% CI	
Model 1: R^2 = 0.13; F = 13.717; p < .001							
[a]*Step 1*							
Age	−0.014	0.004	−0.148	−3.382	0.001	−0.022	−0.006
Gender	−0.825	0.304	−0.105	−2.714	0.007	−1.421	−0.228
Shift work	−0.023	0.021	−0.042	−1.074	0.283	−0.064	0.019
Seniority	0.014	0.006	0.101	2.316	0.021	0.002	0.026
Step 2							
Job Strain (JS)	0.708	0.145	0.188	4.868	0.000	0.422	0.993
Reckless & Careless style (RS)	0.321	0.085	0.150	3.752	0.000	0.153	0.488
Step 3							
JS*RC	1.468	0.298	1.026	4.931	0.000	0.884	2.053
Model 2: R^2 = 0.17; F = 19.007; p < .001							
Step 2							
Job Strain (JS)	0.686	0.144	0.182	4.763	0.000	0.403	0.969
Anxious style (AS)	0.401	0.082	0.197	4.912	0.000	0.241	0.562
Step 3							
JS*AS	1.764	0.257	1.227	6.871	0.000	1.260	2.268
Model 3: R^2 = 0.09; F = 8.810; p < .001							
Step 2							
Job Strain (JS)	0.766	0.146	0.203	5.243	0.000	0.479	1.053
Angry & hostile style (AH)	0.108	0.060	0.071	1.795	0.073	−0.010	0.225
Step 3							
JS*AH	0.491	0.247	0.417	1.991	0.047	0.007	0.975
Model 4: R^2 = 0.08; F = 8.092; p < .001							
Step 2							
Job Strain (JS)	0.804	0.144	0.213	5.571	0.000	0.520	1.087
Patient & careful style (PC)	−0.097	0.070	−0.052	−1.375	0.170	−0.234	0.041
Step 3							
JS*PC	−0.260	0.317	−0.264	−0.819	0.413	−0.882	0.363

[a] *Notes:* Coefficients in step 1 are the same in the four regression models.

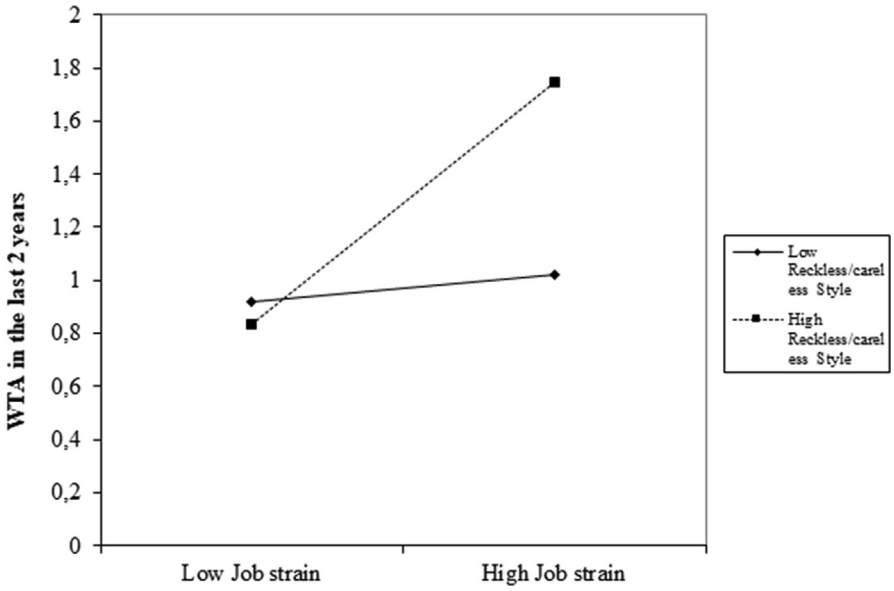

Fig. 1. Multiplicative interaction between job strain and reckless & careless driving style predicting WTC.

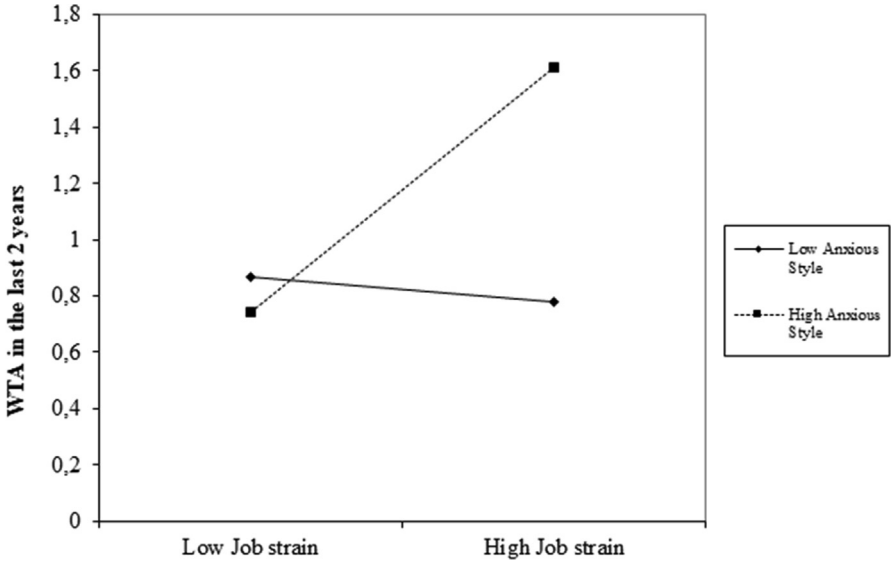

Fig. 2. Multiplicative interaction between job strain and anxious driving style predicting WTC.

Reckless & Careless (see Fig. 1. Gradient of slope = 1.680, t = 8.739, p < .001), Anxious (see Fig. 2. Gradient of slope = 1.611, t = 8.972, p < .001), and Angry & hostile diving styles (see Fig. 3. Gradient of slope = 1.134, t = 5.367, p < .001).

4. Discussion

This study examined whether driving styles modify (i.e. moderate) the effect of job strain (stress indicator of the Karasek's JDC model) on professional drivers' WTC. Consistently with hypotheses 1, 2, 3 and 4, respectively, it was found that job strain is positively associated with WTCs, and that such association is exacerbated by the Reckless & Careless (hypothesis 1), Anxious (hypothesis 2), and Angry & hostile (hypothesis 3) diving styles. In other words, it was found that maladaptive driving styles are vulnerability factors playing a role in negative stress-related safety outcomes. However, contrary to what was expected, the Patient & careful driving style was not associated with a lower risk of WTC, nor with a lower vulnerability to job strain (hypothesis 5).

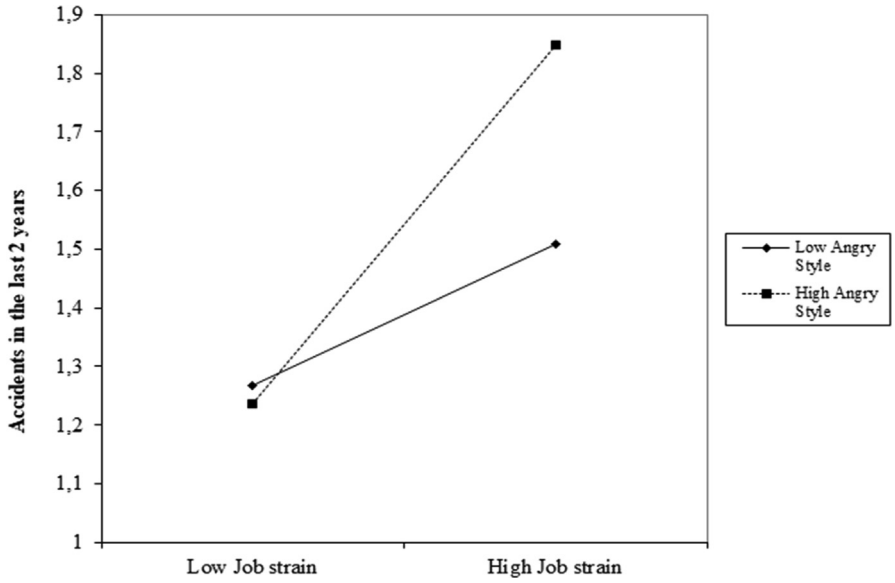

Fig. 3. Multiplicative interaction between job strain and angry & hostile diving style predicting WTC.

The results of this study are consistent with the existing evidence on the association between job strain and WTC in professional drivers (Gómez et al., 2018; Useche et al., 2017; Useche et al., 2018). Furthermore, the reported findings complement the literature on individual traits that modify the association between stressful working conditions and health/safety outcomes, which, up to date, has focused especially on the moderating effect of general personality traits such as neuroticism (Batista & Reio, 2019; Grant & Langan-Fox, 2007; Liu et al., 2009), conscientiousness, extraversion and agreeableness (Chu et al., 2019; Dijkstra et al., 2005). Unlike these investigations, the present study provides evidence on lower level individual traits, such as driving styles, which determine the stress appraisal and coping behaviors in more specific situations, such as professional driving. Given the proximity between driving styles and stress-related behaviors on the road, the evidence collected by this research can be useful for designing occupational safety and health interventions, focused on job strain management and WTC prevention.

Firstly, the importance of work strain as a predictor of WTC suggests that organizational-level interventions at work can contribute to improving road safety outcomes in passenger land-transport companies. Notably, very few scientific interventions have focused on the occupational stressors of professional drivers. However, the available evidence suggests that improving working conditions (e.g. workload, rest periods, organizational communication, social support) in this occupational group can generate positive individual and organizational outcomes (Evans, Johansson, & Rydstedt, 1999; Kompier, Aust, van den Berg, & Siegrist, 2000). Additionally, findings in other occupational groups suggest that organizational programs aimed at reducing demands (e.g. shortening driving times) and increasing decision latitude or job control (e.g. planning one's own shift schedules and rest periods) are affective to improve the workers' well-being and organizational performance (Landsbergis, 2009; Montano, Hoven, & Siegrist, 2014). At the same time, the negative association between job strain and Patient & careful style indicates that healthy work conditions may contribute to the adoption of adaptive driving styles, which help to prevent WTC, even though, according to the results of this study, they do not imply a reduction in stress vulnerability.

Additionally, individual-level interventions focused on stress management and positive road behaviors may improve safety outcomes among Bogotá taxi and bus drivers. In particular, the findings on the stress*driving style interaction points out that drivers with Reckless & Careless, Anxious, and Angry & hostile diving styles require, under stressful work conditions (e.g. high job strain), more attention in terms of driving behavior monitoring. The problem with driving styles is that, as considerably stable individual traits, they are difficult to modify. For instance, Zhang et al. (2018) found that training in hazard detection is not effective in the case of careless drivers, because, probably, they have problems in modifying their behavior accordingly with the skills developed by the intervention program (e.g. they learn to detect danger, but are reluctant to monitor potentially dangerous situations while driving). However, there is evidence that education and training programs, such as behavior feedback/coaching, reduce involvement in road risky situations and contribute to changing driving styles (Sagberg, Selpi, Bianchi-Piccinini, & Engström, 2015). These interventions can be especially effective when accompanied by monitoring technologies, such as video-based onboard monitoring systems, which help transport companies with the detection and feedback given to drivers about their own risky behaviors at the wheel (Hickman & Hanowski, 2011; Kang, 2013). As job strain and driving styles were evaluated using generic measurements (not specific for bus and taxi drivers), and several working conditions are similar for most workers in the ground transportation industry in Bogotá (e.g. time

pressure, shift work, overtime, high attentional demands, road overcrowding), these intervention lines could be extended to groups of professional drivers of the city, similar in terms of (e.g.) demographic features, working conditions and public transportation modes.

5. Conclusion

The aim of this study was to examine whether driving styles modify (i.e. moderate) the effect of job strain on professional drivers' occupational crashes. Regression based moderation analyses suggests that job strain is positively associated with WTC's likelihood, and that such association is stronger in drivers with Reckless & Careless, Anxious, and Angry & Hostile diving styles. Meanwhile, the Patient & Careful driving style was not associated with a lower risk of being involved in a work traffic crash, nor with a lower vulnerability to stress at work. In practical terms, these findings support the design of organizational and individual safety interventions focused on decreasing job strain and modifying driving styles, bearing in mind different evidence supporting the idea that the way the driver chooses to drive or habitually drives may increase his/her vulnerability to stress situations that are typical of the road environment.

6. Limitations of the study

Finally, it is worth acknowledging that this research had a set of methodological limitations that may bias the results:

We used a cross-sectional design, which prevents the attributions of causality in the associations between variables.

Secondly, the convenience sampling substantially affects the generalizability of the findings on a population level, in occupational groups of bus and taxi drivers. In addition, the exclusive use of self-report measures increases the risk of biased results, since it is not possible to establish whether the data reflects objective information or rather the participants' perception of their working conditions and driving behaviors. Furthermore, it is visible how the industry of transportation is still highly gendered in many countries, fact that prevents us from performing sex-based comparisons.

Also, the retrospective evaluation and general character of the criterion variable (WTCs, regardless of their severity) also prevents us from establishing causal relationships, since factors such as (*i*) the lack of objective crash reports for corroboration, (*ii*) the potential over/underestimation of accidents among drivers, and (*iii*) the lack of a severity-based differentiation of crashes (which could potentially explain differences in job strain and driving styles), limit the scope of the data retrieved in this study.

Nevertheless, the anonymity preserved during the data collection, and the high reliability and consistency of the instruments (JCQ and MDSI), partially compensate these limitations. However, future research based on observational, longitudinal, and experimental designs could make relevant contributions to the study of safety outcomes associated with job strain and driving styles.

CRediT authorship contribution statement

Sergio A. Useche: Conceptualization, Methodology, Investigation, Writing - original draft, Writing - review & editing. **Boris Cendales:** Data curation, Writing - original draft, Writing - review & editing. **Francisco Alonso:** Visualization, Supervision, Software. **Mauricio Orozco-Fontalvo:** Conceptualization, Software, Writing - review & editing.

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