Original Road Safety Research

Organisational Safety Climate, Professional Driver Behaviours, and Crashes Among a Mixed Group of Professional Drivers

Şerife Yılmaz[1], Türker Özkan[1] and Bahar Öz[1]

[1]*Safety Research Unit, Department of Psychology, Middle East Technical University, Ankara, Turkey*

Corresponding Author: Şerife Yılmaz, Safety Research Unit, Department of Psychology,
Middle East Technical University, 06800, Ankara, Turkey., serifey@metu.edu.tr, +90 312 2103144.

Key Findings

- The study utilised scales developed explicitly for professional drivers
- Driver groups differed on driver behaviours but not on safety climate and crashes
- Freight vehicles reported risky driver behaviours more than passenger vehicles
- Higher work and time pressure was related to speeding, rule violation, and tiredness
- Tiredness positively predicted crashes in the mixed professional driver group

Abstract

The current study compared different driver groups and investigated the relationship between safety climate, driver behaviours, and crashes in a mixed group of professional drivers in Turkey. Two hundred and sixty drivers completed the scales developed explicitly for professional drivers, Transportation Companies' Climate Scale and Occupational Driver Behaviour Questionnaire, along with the demographic form. Freight drivers scored higher on risky driver behaviours than passenger vehicle drivers. Organisational safety climate predicted driver behaviours. When the organisations are more sensitive regarding work and time pressure issues (low level of pressure), drivers are less likely to speed, violate the rules, and get tired. Additionally, risky driver behaviours were related to more crashes. Specifically, driving while tired positively predicted crashes after controlling for the effects of age and annual mileage. Altogether, a favourable safety climate predicted safer driving behaviours, which was found to be related to fewer crashes. The results were discussed in detail.

Keywords

professional driver, driver behaviour, organisational safety climate, safety in the workplace, safety culture, driving crash

Introduction

Safety Climate

Organisational climate is defined as a "summary of molar perceptions that employees share about their work environment" (Zohar, 1980, p. 96). According to Zohar (1980), these perceptions have a psychological utility that provides a frame of reference for behaviours and guide appropriate and adaptive task behaviours of organisation members. Safety climate is described as 'the objective measurement of attitudes and perceptions toward occupational health and safety issues' (Coyle et al., 1995, p. 247) and evaluated as a subset of organisational climate. Likewise, Zohar (1980) also mentioned that safety climate is an organisational characteristic related to an organisation's safety level. Therefore, attitudinal change at the managerial level and increased commitment to safety are required to improve an organisation's safety level (Zohar, 1980).

Received: 13/09/2021; **Final revised form received:** 23/12/2021; **Accepted:** 15/01/2022; **Available online:** 11/05/2022

Suggested citation: Yılmaz, S., Özkan, T. and Öz, B. (2022). "Organisational Safety Climate, Professional Driver Behaviours, and Crashes Among a Mixed Group of Professional Drivers". *Journal of Road Safety*, 33(2), 5-16. https://doi.org/10.33492/JRS-D-21-00054

It is presented in the literature that safety climate perceptions of drivers are reflected in drivers' driving behaviours (e.g., Amponsah-Tawiah and Mensah, 2016; Öz et al., 2013, 2014; Wills et al., 2006) and, in turn, in the safety outcomes such as road injuries (Zohar et al., 2015) and road traffic crashes (Mehdizadeh et al., 2019). Therefore, it seems essential to establish a favourable safety climate, especially in occupations like professional driving, where the outcome is critical and may be deadly.

Professional Drivers

Professional drivers are referred to as occupational drivers (Newnam et al., 2011), work-related drivers (Wills et al., 2006), company drivers (Amponsah-Tawiah & Mensah, 2016), and commercial motor vehicle drivers (Morrow & Crum, 2004). This specific driver group referred to as professional drivers in this article, is defined as driving for professional purposes; driving is either their main job or a part of their job.

Professional drivers are a high-risk group for crash involvement since they have a high level of exposure (i.e., high mileage) to the traffic environment relative to other drivers (Baker et al., 1976). For example, according to road traffic crash statistics in Turkey (Türkiye İstatistik Kurumu [TÜİK], 2020), crash involvement of vehicles such as light trucks, trucks, tow trucks, minibusses, and buses constitutes 24.1% of all crashes. Moreover, according to the Social Security Institution of Turkey (2020), nearly 18% (n = 219) of people in the transportation sector (e.g., road, water, air transportation) died as a result of work crashes in 2020. The proportion of worker fatalities in Australia's transportation, postal and warehousing sector was around 32% (n = 58) in 2020 (Safe Work Australia, 2020). Although the reported percentage of workplace fatalities in the transportation sector seems lower in Turkey, the number of people who die is almost four times bigger than in Australia.

Compared to nonprofessional drivers, professional drivers are obliged to follow a predetermined schedule and working hour regulations established by the organisation they are tied to (Caird & Kline, 2004). In other words, driving is more regulated and less flexible for professional drivers since, for instance, the time and speed of driving, route, and vehicle choice are determined by the organisations they are working for (Caird & Kline, 2004). Therefore, while nonprofessional driving is a more self-paced task (Fuller, 2007), professional driving -to a certain extent- is a company-paced task (Öz et al., 2013).

Previous research has shown that professional drivers' driving safety is related to organisation's culture, safety climate, and safety procedures and practices (Öz et al., 2014). Work environment and variations in drivers' work conditions, such as the frequency of contact with their supervisors, interpersonal interactions, or risk that their job involves, may influence their safety climate perceptions differently. Thus, for example, one may argue the extent to which the organisation affects the driving safety of remote/lone drivers working in relative isolation compared to drivers under direct supervision. Similarly, it can be argued whether or to what extent drivers' safety understanding depends on the location, where they work, or time.

Organisational Safety Climate, Driver Behaviours, and Crashes

To study driver behaviours of professional drivers, some studies (e.g., Öz et al., 2014) used Driver Behaviour Questionnaire (DBQ; Reason et al., 1990), while some studies modified the DBQ according to the work context and particular practices of professional drivers (e.g., Wills et al., 2006). Moreover, some driver group-specific scales were developed and used, such as Occupational Driver Behaviour Questionnaire (ODBQ; Newnam et al., 2011).

Öz and colleagues (2014) showed that when the safety climate in an organisation is stronger (e.g., rewarding safe behaviours, effective driver-management communication, having a clear schedule), the driver behaves more safely, such as committing fewer errors and violations. Mehdizadeh and colleagues (2019) showed that errors and violations of taxi and truck drivers are positively associated with crashes. Mamo and colleagues (2014) also found a positive relationship between the total score of ODBQ and crashes for work-related drivers.

Likewise, a favourable safety climate predicted the safety behaviours of bus (Chen et al., 2019) and truck drivers (Zohar et al., 2015). Amponsah-Tawiah and Mensah (2016) revealed that drivers are less likely to engage in speeding, rule violation, inattention, and driving while tired when the organisation has a favourable safety climate. They have suggested that the safety climate is affected by organisations' commitment to safety-related practices and policies and affects drivers' driving behaviours. Also, Useche and colleagues (2017) showed that work stressors such as job strain and low social support in the working environment predicted risky behaviours of bus rapid transport drivers through fatigue. Furthermore, Varonen and Matilla (2000) revealed that a favourable safety climate (i.e., a company's attitudes to safety and company safety precautions) correlates with lower crash rates. Similarly, Öz (2011) reported that safety climate (i.e., general safety dimension) is negatively associated with self-reported crashes for professional drivers.

The design of the current study, including multiple vehicle groups, provided an opportunity for exploring the safety climate, driver behaviours, and crashes in a mixed group of professional drivers. Most of the previous research has utilised either light or heavy motor vehicles, not a combination of different driver groups (Huang et al., 2013; Meng et al., 2015).

Aim of the Current Study

The current study compared professional driver groups on safety climate, driver behaviours, and crashes. In other words, it was expected that driver groups differ from each other in terms of their perceptions and evaluations of the organisational safety climate, level of engagement with different risky driver behaviours and the number of crashes. Moreover, it was aimed to investigate the relationship between organisational safety climate, professional driver behaviours, and crashes in a mixed group of professional drivers in Turkey. Specifically, it is expected that safety climate will predict driver behaviours and driver behaviours will predict crashes over and above age and annual mileage.

Method

Participants and Procedure

Ethical approval was obtained from Middle East Technical University Human Subjects Ethics Committee (2016-SOS-052). Participants were informed, assured anonymity, and consented that their participation was voluntary and that the results would be used for only scientific purposes. A total of 260 drivers participated in the study. The details of the characteristics of the driver groups and sample can be found in Table 1. Paper-pencil surveys were posted via mail service to a manager who assisted in delivering these surveys to the drivers (i.e., van and cargo drivers). These surveys were in closed envelopes to further assure participants that their responses would not be shared with the company and be kept anonymous. The remaining data were collected by visiting professional drivers in their stopping places or via announcements on social media platforms. Paper-pencil surveys were delivered and collected in person to taxis, dolmuş (i.e., like a minibus; a type of public transportation that operates in cities at predetermined routes according to a timetable, having certain stopping places), school buses, and bus drivers. First, the managers or the responsible persons in the organisation were informed about the study, and then the first author invited drivers in person to participate in the study. Since not all the drivers were available during the visit, empty surveys with informed consent were given to one of the drivers who were asked to distribute the survey to his colleagues. The researcher collected the surveys back within a week.

Measures

Occupational Driver Behaviour Questionnaire (ODBQ)

ODBQ measures driver behaviours of occupational drivers and includes 12 items (Newnam et al., 2011), and it consists of four dimensions: speeding, rule violation, inattention, and tiredness. Each dimension has three items. It was translated into Turkish and used for the first time in this study. The first author of the original article was contacted via e-mail and asked for permission to use their questionnaire. The first author translated the questionnaire into Turkish, and the translation was revised by the last author, who both are native Turkish speakers. Later, the revised Turkish version was back-translated to English by an independent native Turkish speaker fluent in English. Lastly, the authors compared the back-translated version of the questionnaire with the original one regarding

Table 1. Characteristics of the sample and driver groups

		Vehicle Types									
Total sample (N = 260)		**Taxi** (n = 19)	**Other** (n = 19)	**More than one vehicle type** (n = 26)	**Dolmuş** (n = 31)	**Bus** (n = 13)	**School bus** (n = 28)	**Van/ pickup** (n = 37)	**Lorry** (n = 5)	**Trailer truck** (n = 21)	**Cargo Car** (n = 61)
Four-group comparison		Group 1 (n = 60*)			Group 3 (n = 73)			Group 4 (n = 66)			Group 2 (n = 61)
	Age	M = 37.29, SD = 10.31			M = 44.59, SD = 10.48			M = 36.24, SD = 7.76			M = 32.73, SD = 4.94
	Annual mileage	M = 67669.39, SD = 44925.44			M = 41534.92, SD = 39772.71			M = 77966.10, SD = 48169.95			M = 44489.80, SD = 27984.46
Two-group comparison		Passenger (Group 1 and Group 3) (n = 133)						Freight (Group 2 and Group 4) (n = 127)			
	Age	M = 41.38, SD = 10.98						M = 34.58, SD = 6.79			
	Annual mileage	M = 52968.75, SD = 43885.55						M = 62777.78, SD = 43467.54			

Note: * 1 participant was transferred to Group 3, and 3 participants were transferred to Group 4 based on the vehicle type.

conceptual, semantic, and content equivalence. It was found equivalent to the original questionnaire; therefore, the translation process was completed. Drivers were asked to rate the frequency of each behaviour they engage in while in the traffic environment over a 5-point Likert scale (1 = rarely or never, 5 = very often). Higher scores indicated higher levels of the given behaviour. Cronbach's alpha for internal consistency scores in the current study was found as .84 for speeding, .61 for rule violation, .83 for inattention, and .77 for tiredness.

Transportation Companies' Climate Scale (TCCS)

TCCS measures the organisational safety climate of transportation companies and includes 31 items (Öz et al., 2013) by three dimensions: work and time pressure, specific practices and precautions, and general safety management, dimensions having 7, 8, and 16 items, respectively. Drivers were asked to rate the extent to which they agreed to the items over a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Higher scores indicated safer safety climate perceptions compared to lower scores. Cronbach's alpha for internal consistency scores in the current study was .79 for work and time pressure, .90 for specific practices and precautions, and .93 for general safety management.

Results

Correlation Analyses

As presented in Table 2, age was negatively correlated with all dimensions of ODBQ and the number of crashes. Annual mileage driven as a professional driver yielded a negative correlation with all dimensions of TCCS and driving while tired. Speeding and tiredness were negatively correlated with all dimensions of the TCCS, but rule violation is negatively associated with general safety management and work and time pressure. Crashes yielded a positive correlation with speeding and tiredness. Additionally, crashes negatively correlated with work and time pressure, which means that the number of crashes increased when work and time pressure-related issues were not given importance within the organisation. Bonferroni correction was applied to compare the correlations between 10 variables. The significance level (0.05) was divided into the comparison number (Weisstein, 2020); therefore, the alpha level was computed as 0.001. Correlations significant at the 0.001 level were marked in bold letters (see Table 2).

Analyses of Covariance

Since the individual vehicle groups were not equally represented in the sample, four groups were created considering the diversity and the distribution of the sample. Drivers providing private transportation for a small number of people (e.g., taxi), drivers of typical vehicles that cannot be grouped in the current sample (e.g., jeep drivers, official cars, ambulance), and drivers driving more than one vehicle for professional purposes were all grouped under Group 1. Group 2 included drivers who usually carry cargo within the city (cargo drivers). In group 3, there were drivers of public vehicles carrying passengers in or out of the study (dolmuş, bus, and school bus). Drivers who usually carry large goods and loads in and out of the city are called Group 4 (van/pickup, lorry, trailer truck). Also, two higher-order groups were created based on what vehicles carry. The first group included the drivers of vehicles primarily carrying passengers, called passenger

Table 2. Correlations among dimensions of the scales used in the present study

		1	2	3	4	5	6	7	8	9	10
1	Age	1									
2	Annual Mileage	-.050	1								
3	Crash	-.191**	.010	1							
4	TCCS Work and Time Pressure (WTP)	-.002	-.157*	-.138*	1						
5	TCCS Specific Practices and Precautions (SPP)	.096	-.155*	-.072	**.201****	1					
6	TCCS General Safety Management (GSM)	.104	-.154*	-.015	.133*	**.799****	1				
7	ODBQ Speeding	-.191**	.071	**.208****	**-.310****	**-.205****	**-.226****	1			
8	ODBQ Rule Violation	-.128*	.029	.119	-.181**	-.109	-.141*	**.513****	1		
9	ODBQ Inattention	-.166**	.078	.080	-.058	-.012	-.037	**.324****	**.355****	1	
10	ODBQ Tiredness	-.184**	.197**	**.246****	**-.313****	-.139*	-.151*	**.448****	**.467****	**.394****	1

Note: *Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). Bold indicates significance at the .001 level (Bonferroni Correction).

vehicles, and the second group composed of the vehicles primarily carrying goods, called freight vehicles (see Table 1). These groups were compared in terms of organisational safety climate, driver groups, and crashes (four-group comparisons and two-group comparisons).

Organisational safety climate by driver groups

After controlling the effects of age and annual mileage, a between-subject MANCOVA was performed to compare the four driver groups on three subscales of organisational safety climate. Analysis revealed a nonsignificant main effect ($p = .15$). Passenger and freight groups also revealed a nonsignificant effect on safety climate ($p = .14$).

Driver behaviours by driver groups

After controlling the effects of age and annual mileage, a between-subject MANCOVA was performed to compare the different driver groups on four subscales of driver behaviour. Significant main effect of driver groups was observed [F (12, 540,025) = 4.56 $p < .001$, Wilks' Lambda = .78 $\eta p^2 = .08$]. The pairwise comparison with Bonferroni correction revealed that Group 2 committed more rule violations than Group 1, 3, and 4. Group 2 had the highest inattention score and significantly differed from Group 1 and Group 3, while Group 1 and Group 3 did not significantly differ from each other. Group 4 had higher inattention score than Group 1. There was no significant relationship between the groups and speeding behaviour (see Table 3).

After the four-group comparison, two higher-order groups were compared in terms of driver behaviour. A MANCOVA analysis after controlling for the effect of age and annual mileage revealed that vehicle type (i.e., passenger vs. freight) has an effect on driver behaviour [F (4, 206) = 8.07, $p < .001$, Wilks' Lambda = .87 ηp^2 = .14]. Results revealed that freight vehicles are more engaged in speeding, rule violation, inattention, and tiredness than passenger vehicles (see Table 3).

Lastly, to observe whether the four groups and passenger and freight vehicles differ on general risky driver behaviour, a composite ODBQ mean score was created, and separate ANCOVAs were conducted by controlling for age and annual mileage. Accordingly, main effect of 4 groups on general risky driver behaviour was significant [F (3, 215) = 13.73, $p < .001$, $\eta p^2 = .16$]. Group 2 and Group 4 reported higher engagement with risky driver behaviour than Group 1 and Group 3. However, Group 2 and Group 4 did not significantly differ from each other. According to other ANCOVA analyses, passenger and freight vehicles significantly differed from each other in general risky driver behaviours [F (1, 209) = 23.57, $p < .001$, $\eta p^2 = .10$]. Freight vehicles reported risky driver behaviours more than passenger vehicles ($p < .001$).

Crashes by driver groups

After controlling the effects of age and annual mileage, ANCOVA was performed to observe whether driver groups differ from each other in terms of crash involvement. 4-group comparison showed nonsignificant results (p = .06). Also, no significant difference was observed between passenger and freight vehicles (p = .22).

Hierarchical Regression Analyses

Hierarchical regression analyses were undertaken to examine the relationship between organisational safety climate, driver behaviour, and crashes. Age and annual mileage were entered in each analyses' first step to control their effects. Thus, in the second step, the sole contributions of organisational safety climate to driver

Table 3. Results of group comparisons

	Four-group comparison						Two-group comparison			
	Group 1 (n = 46)	Group 2 (n = 48)	Group 3 (n = 60)	Group 4 (n = 59)	F	Partial eta (ηp^2)	Passenger (n = 106)	Freight (n = 107)	F	Partial eta (ηp^2)
ODBQ Speeding	1.37 (.10)	1.61 (.10)	1.36 (.10)	1.61 (.09)	1. 94	.03	1.36^{a} (.07)	1.61^{b} (.07)	5.88*	.03
ODBQ Rule violation	1.37^{a} (.09)	1.74^{b} (.09)	1.34^{a} (.09)	1.39^{a} (.08)	4. 27*	.06	1.36^{a} (.06)	1.54^{b} (.06)	4.25*	.02
ODBQ Inattention	1.87^{a} (.18)	3.33^{b} (.18)	2.14^{ac} (.17)	2.73^{bc} (.16)	13.30**	.16	2.01^{a} (.12)	3.01^{b} (.12)	31.97**	.13
ODBQ Tiredness	1.38^{a} (.11)	1.70^{ab} (.11)	1.62^{ab} (.10)	1.77^{b} (.10)	2.84*	.04	1.51^{a} (.07)	1.75^{b} (.07)	5.59*	.03
	Group 1 (n = 49)	Group 2 (n = 49)	Group 3 (n = 63)	Group 4 (n = 59)	F	Partial eta (ηp^2)	Passenger (n = 106)	Freight (n = 107)	F	Partial eta (ηp^2)
ODBQ Total	1.48^{a} (.08)	2.13^{b} (.08)	1.56^{a} (.08)	1.89^{b} (.08)	13.73**	.16	1.56^{a} (.06)	1.98^{b} (.06)	23.57**	.10

Note: Group 1: taxi, other, more than one vehicle; Group 2: cargo drivers; Group 3: dolmuş, bus, and school bus; Group 4: van/pickup, lorry, trailer truck. Mean replacement or imputation for missing values was not applied; thus, group's sample size varies. Scoring was over a 5-point Likert scale (1 = rarely or never, 5 = very often). Mean values with different superscripts within rows are significantly different from each other. Standard errors are indicated in parentheses.
* $p < .05$, ** $p < .001$.

Table 4. The relationship between organisational safety climate and driver behaviour

Steps	Independent variables	R^2	Adj. R^2	$R^2\Delta$	F	$F\Delta$	df	Beta
ODBQ Speeding as DV								
1st Step		.040	.031	.040	4.39	4.39**	2, 210	
	Age							-.188**
	Annual mileage							.061
2nd Step		.161	.140	.121	7.93	9.92***	3, 207	
	TCCS WTP							-.291***
	TCCS SPP							.012
	TCCS GSM							-.180
ODBQ Rule Violation as DV								
1st Step		.017	.007	.017	1.79	1.79	2, 210	
	Age							-.126
	Annual mileage							.022
2nd Step		.062	.039	.045	2.73	3.23*	3, 207	
	TCCS WTP							-.176**
	TCCS SPP							.058
	TCCS GSM							-.155
ODBQ Inattention as DV								
1st Step		.032	.023	.032	3.51	3.51*	2, 210	
	Age							-.162*
	Annual mileage							.070
2nd Step		.037	.013	.004	1.57	.30	3, 207	
	TCCS WTP							-.055
	TCCS SPP							.074
	TCCS GSM							-.062
ODBQ Tiredness as DV								
1st Step		.069	.060	.069	7.80	7.80***	2, 210	
	Age							-.175**
	Annual mileage							.188**
2nd Step		.158	.137	.089	7.76	7.27***	3, 207	
	TCCS WTP							-.287***
	TCCS SPP							.042
	TCCS GSM							-.108
ODBQ Total as DV								
1st Step		.061	.052	.061	6.81	6.81***	2, 210	
	Age							-.215**
	Annual mileage							.112
2nd Step		.124	.103	.063	5.87	4.98**	3, 207	
	TCCS WTP							-.239***
	TCCS SPP							.128
	TCCS GSM							-.156

Note: Mean replacement or imputation for missing values was not applied, thus sample size drops from 260 to 212.
* $p < 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

behaviour and driver behaviour to crashes beyond the control variables have been observed.

Organisational safety climate and driver behaviours

The relationship between the organisational safety climate measured by TCCS (i.e., predictor variable) and driver behaviour measured by ODBQ (i.e., outcome variable) was examined. Four different hierarchical regression analyses (see Table 4) were undertaken using speeding, rule violation, inattention, and tiredness as the dependent variables (DV). Organisational safety climate variables (i.e., work and time pressure, specific practices and precautions, and general safety management) entered at the second step showed a significant result in terms of driver behaviours [F (5, 207) = 7.93, $p < .001$] after controlling for the effect of age and mileage. Safety climate explained 12% additional variance in speeding, 4.5% in rule violation, and 8.9% in tiredness. Among safety climate dimensions, work and time pressure dimension was the only dimension associated significantly with speeding (95% CI [-0.32, -0.12]), rule violation (95% CI [-0.22, -0.03]), and tiredness (95% CI [-0.35, -0.13]).

Another hierarchical regression analysis using the ODBQ total score as DV was performed. Results showed that organisational safety climate factors explained 6.3% additional variance on general risky driver behaviours over and above the control variables [F (5, 207) = 5.87, $p < .001$]. Specifically, paying attention to work and time pressure issues (95% CI [-0.27, -0.08]) established a relationship with lower levels of risky driver behaviours.

Driver behaviour and crashes

Later, the relationship between ODBQ (i.e., predictor variable) and crashes (i.e., outcome variable) was examined. ODBQ variables entered in the second step showed a significant result regarding crashes [F (6, 198) = 3.51, $p < .01$] over and above age and mileage (see Table 5). Altogether, the dimensions of ODBQ explained a 6% additional variance in crashes. However, only the tiredness dimension was significantly related to crashes (95% CI [0.07, 0.57]).

The last hierarchical regression analysis used the ODBQ total score as IV to predict crashes after controlling for age and annual mileage. Results showed that general risky driver behaviours explained 6% additional variance on crashes [F (3, 195) = 7.13, $p < .001$]. In other words, an increase in risky driver behaviours (95% CI [0.19, 0.66]) is related to an increase in crashes.

Discussion

In the current study, different professional driver groups were compared in organisational safety climate, driver behaviours, and crashes. Also, the relationship between

Table 5. The relationship between driver behaviour and crashes

Steps	Independent variables	R^2	**Adj.** R^2	$R^2\ \Delta$	F	$F\ \Delta$	df	**Beta**
Driver Behaviour as DV								
1st Step		.037	.027	.037	3.83	3.83*	2, 202	
	Age							-.191**
	Annual mileage							.001
2nd Step		.096	.069	.060	3.51	3.27**	4, 198	
	ODBQ Speeding							.128
	ODBQ Rule Violation							-.045
	ODBQ Inattention							-.049
	ODBQ Tiredness							.211**
ODBQ Total as DV								
1st Step		.039	.029	.039	3.97*	3.97*	2, 196	
	Age							-.198**
	Annual mileage							-.003
2nd Step		.099	.085	.060	7.13	12.96***	1, 195	
	ODBQ Total							.252***

Note: Mean replacement or imputation for missing values was not applied, thus sample size drops from 260 to 204 for ODBQ dimensions and 260 to 198 for ODBQ Total. * $p < .05$; ** $p \leq 0.01$; $p < .001$.

organisational safety climate and driver behaviours and the relationship between driver behaviours and crashes were explored in a mixed group of professional drivers. According to the correlation between safety climate and behaviour, the drivers of organisations with a favourable safety climate were less likely to be involved in speeding, rule violation, and driving while tired (Amponsah-Tawiah & Mensah, 2016). Crashes were positively correlated with speeding and tiredness (Mamo et al., 2014) and negatively associated with being sensitive about work and time pressure dimension of safety climate.

Group Comparisons

Group comparisons showed that driver groups engaged in risky driver behaviours differently. Unlike Mehdizadeh et al. (2019), freight carrying drivers (i.e., Group 2 and Group 4) reported higher risky driver behaviours than passenger-carrying drivers. Due to their job's characteristics, drivers carrying goods drive longer kilometres than other groups (see Table 1); therefore, it is plausible that they will get tired and inattentive with time. Since their destination and timetable are predetermined, freight vehicles may violate the rules and increase their speed to conform to the schedule.

Moreover, results showed that drivers of vehicles carrying passengers and goods in and out of the city did not differ on climate perceptions and evaluations of organisations. There may be several explanations. The organisations that participated in the study (e.g., taxi, dolmuş, school bus) may lack an obvious safety climate, that resulted in no difference between groups. These organisations may have safety climate at a similar level such as pathological or reactive level (Lawrie et al., 2006), so their perception does not significantly differ. It may be argued that micro-level factors such as individual differences can play a role in the lack of strong organisational safety climate perceptions and driver group identity. Also, measurement of safety climate may be a reason for no difference. For example, safety climate perception shaped at group-level (Huang et al., 2013) in communication with the immediate environment such as direct supervisor and workgroup, might be a sensitive measure to compare different driver groups, rather than measuring broader organisational level climate perception. Additionally, some studies discussed if lone/remote workers develop a general safety perception regarding the organisation they are tied to (Huang et al., 2013). Öz and colleagues (2014) asserted that the work place for lone drivers might be the vehicle itself; therefore, they proposed Trip-focused Organisational Climate Scale to measure drivers' safety climate perception while driving. Nevertheless, there is evidence of the emergence of safety climate perceptions for lone workers (i.e., long-haul truckers), influencing their driving behaviours despite relative social isolation and their limited interaction with the organisation and its members (Huang et al., 2013; Zohar et al., 2015).

Moreover, driver groups did not differ in crash involvement. Wu and colleagues (2016) showed that taxi drivers exhibited a lower crash involvement rate than nonprofessional drivers, whereas Wang and colleagues (2014) showed that taxi drivers were inclined to have crashes more than bus, lorry, company car, and shuttle drivers. Useche et al. (2020) revealed that fatal crash risks were reported by buses, articulated buses and semi-trailer trucks more than cargo (truck) and passenger carriers (van and minibus). In contrast, van drivers indicated crashes with serious injury risks more than cargo and passenger drivers. However, in line with the current study, Useche and colleagues (2018) presented no significant difference between different driver groups' crash involvement, such as city bus, interurban bus, and taxi drivers. It should be noted that these four groups and two higher-order groups were arbitrarily created based on their working conditions (if they carry passengers as private or public transportation and goods or cargo in and out of the city). Therefore, the results should be interpreted with caution due to the varying nature of arbitrarily created driver groups.

Organisational Safety Climate and Driver Behaviours

Although driver groups did not differ from each other in organisational safety climate, as expected, organisational safety climate predicted risky driver behaviours in a mixed group of professional drivers (Amponsah-Tawiah & Mensah, 2016; Öz et al., 2013, 2014; Zohar et al., 2015). Work and time pressure was the most associated dimension with risky driver behaviours among all safety climate dimensions for professional drivers driving different vehicles for various purposes and having different working conditions. Specifically, professional drivers were less likely to speed, violate the rules, and drive while tired when organisations were more sensitive regarding work and time pressure issues (low level of pressure). Similarly, Cœugnet and Miller et al. (2013) showed that drivers tend to increase their driving speed under time pressure. In addition to speeding, time-pressured drivers reported more risk-taking and rule violation behaviours (Cœugnet, Naveteur, et al., 2013). Congruently, a negative relationship between safety climate and violations has been established in previous studies (e.g., Öz et al., 2013, 2014; Sullman et al., 2017). In particular, Sullman et al. (2017) suggested that violations might result from work pressure where pressure outweighs safety concerns in an organisation. For driving while tired, Wills et al. (2006) revealed that work pressure is associated with driving while tired. As a result, the current study revealed that higher work and time pressure is related to risky driver behaviours, whereas drivers behave more safely when the pressure is low (Mamo et al., 2014).

Furthermore, no significant association between organisational safety climate dimensions and the inattention dimension of ODBQ was observed. The inattention dimension is similar to lapses, 'covert' forms of memory failures (Reason et al., 1990), which is an unintentional form of driver behaviour compared to violations, deliberate deviations of safe practices (Reason et al., 1990). Reason and colleagues suggested that lapses result from failure of cognitive competencies, whereas violations relate to motivational factors (e.g., trade between safe mobility and speed). It was also revealed that lapses are less likely to impact driving safety (Parker et al., 1995). It can be claimed that organisational safety climate factors affect intentional components of driver behaviour like speeding, rule violation, and tiredness, which are also related to motivational factors; however, it does not affect unintentional components such as inattention.

Driver Behaviours and Crashes

As expected, the present study showed the relationship between risky driver behaviours and the number of crashes. Specifically, tiredness positively predicted crashes after controlling for age and annual mileage. Previous studies have shown a positive association between driver behaviour and crashes in professional drivers (e.g., Mamo et al., 2014; Mehdizadeh et al., 2019; Sullman et al., 2017). Specifically, according to Meng et al. (2015), the main contributor to taxi drivers' crash involvement was fatigue (i.e., prolonged driving time). Similarly, professional drivers reported sleepiness/sleeplessness and tiredness among the reasons for traffic crash involvement (Yılmaz et al., 2019). Furthermore, Santos and Lu (2016) revealed that fatigue or tiredness is the most commonly experienced health and safety problem by bus drivers due to the long work hours, ultimately causing crashes. Morrow and Crum (2004) showed that in a sample of commercial motor vehicle drivers, unfavourable safety climate and pressure to drive while tired is related to fatigue and near miss.

Since the supervisory decision is an important predictor concerning the safety climate perception of employees (Zohar & Luria, 2004), when production motivation outweighs safety, employees would behave at the expense of safety (Zohar, 2010). For example, prioritising production over safety by the management predicted rule violations' acceptability, which affected the employees' engagement with risky behaviour (Rundmo, 2000). In other words, time pressure is associated with economic incentives such as the potential to make more money at the cost of safe driving behaviours and crashes. As Zohar (1980) suggested, understanding safety as an 'integral part of the production system' (p. 101) could result in organisations with a favourable safety climate. For example, the realistic arrangements of the workload and the required time may diminish the risky driving behaviours such as driving while tired, speeding, and rule violation and promote safe driving behaviours, which relates to fewer crashes. Therefore, intervention programs designed explicitly for the targeted change at the organisational, workgroup, and individual level could benefit work-related driving (for details, Newnam & Watson, 2011). Moreover, running a multifaceted intervention program to improve an organisational safety climate may be considered by the organisation (e.g., Bronkhorst et al., 2018). The organisations may also benefit from in-vehicle technologies or ergonomic designs to detect tiredness (i.e., driver fatigue monitoring systems) and tackle drivers' inattention behaviours. Besides, legal regulations, legislation, and deterrent penalties for work and time pressure issues and risky driving behaviours may be imposed, monitored, and evaluated by governments and organisations.

Industry-Specific vs. Generic Scales

Industry-specific scales are suggested to have a stronger predictive validity than the generic ones (Huang et al., 2013; Newnam & VonSchuckmann, 2012) since they are developed to provide more sensitive measurements specific to their context (Öz et al., 2014). Therefore, the scales specifically designed for professional driving have been utilised in the present study (i.e., TCCS and ODBQ) to explore a higher proportion of the relationship between safety climate and driver behaviour. Contrary to expectations, a previous study using TCCS reported a better predictive validity (Öz et al., 2013) in explaining the risky driving behaviours measured by DBQ (Reason et al., 1990). A possible explanation would be that both DBQ and ODBQ scales are designed to measure the same construct, driver behaviour; however, DBQ relies on a human error taxonomy (Reason et al., 1990), and thus, the factors and their scope are different from each other. Additionally, the validity of DBQ has been well established in different samples with various variables; on the other hand, ODBQ is a relatively new scale, and its validity may need further investigation. For example, Newnam and VonSchuckmann (2012) revealed ODBQ being less sensitive to an evaluation of work conditions (i.e., safety climate) as compared to a more individual-related variable (i.e., role overload). Another possible explanation would be related to the sample characteristics. The ODBQ was designed based on occupational drivers driving light vehicles at least one day a week (Newnam et al., 2011); however, the present study sample is heterogeneous. Therefore, ODBQ might have failed to cover the driver behaviour variability of mixed professional driver groups. On the other hand, the current study sample represented various organisations of different sizes and structures. The TCCS may not be sensitive to this kind of organisational variety which could be another reason for the lower predictive validity of TCCS on ODBQ.

Future studies might observe whether the industry-specific scales have more predictive power than generic ones, including both within the same study to reach more conclusive interpretations. Furthermore, a comprehensive driver behaviour scale, including diverse aspects of professional driving for mixed samples, sensitive to the needs of both passenger and freight vehicle groups, might be suggested to develop.

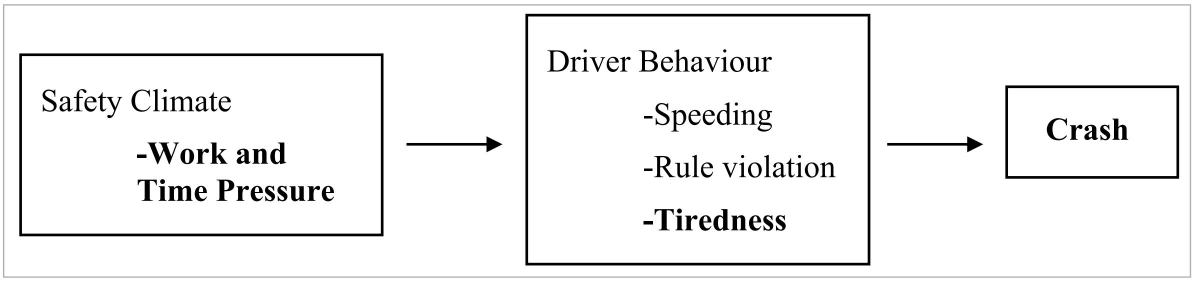

Figure 1. Suggested mediation model

Limitations of the Study

The present study has limitations, such as no female participants being involved in the current sample because professional drivers are mostly male in Turkey. Future studies are suggested to represent female drivers in their sample when applicable so that, for example, they would have a chance to study sex differences. Also, driver groups involved in the sample were not equivalent to each other in sample size, nature of the vehicles, and organisational structure. This difference may have biased the results. Also, the results may suffer from social desirability bias since the study is based on self-report (Yılmaz et al., 2022). Even though anonymity and confidentiality are assured, drivers may deceive themselves (i.e., self-deception) or try to impress others such as their organisation (i.e., impression management) through giving more socially acceptable answers. Therefore, using the social desirability scale and controlling its effect for or combining different methods (e.g., crash records, observations) might be advised for future studies.

Conclusion

In general, professional driver group comparisons are limited in the literature. To the authors' knowledge, safety climate perception of different driver groups or passenger and freight comparisons were not studied previously. There are a limited number of comparative studies on driver behaviours (Öz et al., 2010; Wang et al., 2014), even fewer comparison studies on professional drivers' crash involvement (Mehdizadeh et al., 2019; Useche et al., 2018) that gives an additional value to the current study. The current study showed that when compared separately, driver groups carrying passengers and goods in and out of the city did not differ from each other on organisational safety climate and crashes; however, as a mixed group of professional drivers, organisational climate predicted driver behaviours, and driver behaviours predicted crashes. The current study extends the literature beyond a sample relying on a single professional group such as truck drivers (e.g., Zohar et al., 2015) to a diverse sample of professional drivers. Also, multidimensional professional driving-specific scales (TCCS and ODBQ) have been utilised to compare driver groups and explore relationships in the mixed professional driver group. The results revealed that work and time pressure dimension is critical for predicting speeding, rule violation, and tiredness. Also, tiredness predicted crash involvement. Future studies are suggested to test the mediating role of tiredness in the relationship between work and time pressure and crashes in a larger and representative sample of professional drivers (see Figure 1). Also, a hierarchical moderation with driver groups may be tested in future studies.

In conclusion, the current study results could provide a basis for further studies that may utilise either specific driver groups or representative larger samples from certain companies with strong cultures, policies, and processes.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

The authors declare that there is no conflict of interest.

References

Amponsah-Tawiah, K., & Mensah, J. (2016). The impact of safety climate on safety related driving behaviours. *Transportation Research Part F: Traffic Psychology and Behaviour*, *40*, 48-55.

Baker, S. P., Wong, J. W., & Baron, R. D. (1976). Professional drivers: Protection needed for a high-risk occupation. *American Journal of Public Health, 66*(7), 649-654.

Bronkhorst, B., Tummers, L., & Steijn, B. (2018). Improving safety climate and behaviour through a multifaceted intervention: Results from a field experiment. *Safety Science*, *103*, 293-304.

Caird, K. J., & Kline, T. J. (2004). The relationships between organisational and individual variables to on-the-job driver accidents and accident-free kilometers. *Ergonomics 47*(15), 1598–1613.

Chen, H. K., Chou, H. W., Su, J. W., & Wen, F. H. (2019). Structural interrelationships of safety climate, stress, inattention and aberrant driving behaviour for bus drivers in Taiwan. *Transportation Research Part A: Policy and Practice, 130,* 118–133. https://doi.org/10.1016/j.tra.2019.09.007.

Cœugnet, S., Miller, H., Anceaux, F., & Naveteur, J. (2013). How do time pressured drivers estimate speed and time?. *Accident Analysis & Prevention*, *55*, 211-218.

Cœugnet, S., Naveteur, J., Antoine, P., & Anceaux, F. (2013). Time pressure and driving: Work, emotions and risks. *Transportation Research Part F: Traffic Psychology and Behaviour, 20,* 39-51.

Coyle, I. R., Sleeman, S. D. & Adams, N. (1995). Safety climate. *Journal of Safety Research, 26*(4), 247-254.

Fuller, R. (2007). Motivational determinants of control in the driving task. In Cacciabue P. C. (Ed.), *Modelling Driver Behaviour in Automotive Environments* (pp. 165-188). Springer.

Huang, Y. H., Zohar, D., Robertson, M. M., Garabet, A., Lee, J., & Murphy, L. A. (2013). Development and validation of safety climate scales for lone workers using truck drivers as exemplar. *Transportation Research Part F: Traffic Psychology and Behaviour*, *17*, 5-19.

Jiang, L., Lavaysse, L. M., & Probst, T. M. (2019). Safety climate and safety outcomes: A meta-analytic comparison of universal vs. industry-specific safety climate predictive validity. *Work & Stress*, *33*(1), 41-57.

Lawrie, M., Parker, D., & Hudson, P. (2006). Investigating employee perceptions of a framework of safety culture maturity. *Safety Science, 44*(3), 259-276.

Mamo, W. G., Newnam, S., & Tulu, G. S. (2014). Investigating the individual and organisational predictors of work-related driving crash involvement in Ethiopia. *Transportation Research Part F: Traffic Psychology and Behaviour*, *23*, 156-164.

Maslać, M., Antić, B., Lipovac, K., Pešić, D., & Milutinović, N. (2018). Behaviours of drivers in Serbia: Nonprofessional versus professional drivers. *Transportation Research Part F: Traffic Psychology and Behaviour*, *52*, 101-111.

Maycock, G. (1996). Sleepiness and driving: The experience of UK car drivers. *Journal of Sleep Research*, *5*(4), 229-231.

Mehdizadeh, M., Shariat-Mohaymany, A., & Nordfjaern, T. (2019). Driver behaviour and crash involvement among professional taxi and truck drivers: Light passenger cars versus heavy goods vehicles. *Transportation Research Part F: Traffic Psychology and Behaviour, 62,* 86-98.

Meng, F., Li, S., Cao, L., Li, M., Peng, Q., Wang, C., & Zhang, W. (2015). Driving fatigue in professional drivers: A survey of truck and taxi drivers. *Traffic Injury Prevention*, *16*(5), 474-483.

Morrow, P. C., & Crum, M. R. (2004). Antecedents of fatigue, close calls, and crashes among commercial motor-vehicle drivers. *Journal of Safety Research*, *35*(1), 59-69.

Newnam, S., Greenslade, J., Newton, C., & Watson, B. (2011). Safety in occupational driving: Development of a driver behaviour scale for the workplace context. *Applied Psychology*, *60*(4), 576-599.

Newnam, S., & VonSchuckmann, C. (2012). Identifying an appropriate driving behaviour scale for the occupational driving context: The DBQ vs. the ODBQ. *Safety Science, 50*(5), 1268-1274.

Newnam, S., & Watson, B. (2011). Work-related driving safety in light vehicle fleets: A review of past research and the development of an intervention framework. *Safety Science, 49*(3), 369-381.

Öz, B. (2011). *Professional driving: An emphasis on organisational safety climate*. University of Helsinki, Institute of Behavioural Sciences, Studies in Psychology 78:2011. PhD Thesis. http://urn.fi/URN. ISBN:978-952-10-7275-8.

Özkan, T., & Lajunen, T. (2005). Multidimensional Traffic Locus of Control Scale (T-LOC): Factor structure and relationship to risky driving. *Personality and Individual Differences, 38*(3), 533-545.

Öz, B., Özkan, T., & Lajunen, T. (2013). An investigation of professional drivers: Organisational safety climate, driver behaviours and performance. *Transportation Research Part F: Traffic Psychology and Behaviour*, *16*, 81-91.

Öz, B., Özkan, T., & Lajunen, T. (2014). Trip-focused organisational safety climate: Investigating the relationships with errors, violations and positive driver behaviours in professional driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, *26*, 361-369.

Parker, D., Reason, J. T., Manstead, A. S., & Stradling, S. G. (1995). Driving errors, driving violations and accident involvement. *Ergonomics, 38*(5), 1036-1048.

Reason, J. T., Manstead, A., Stradling, S. G., Baxter, J., & Campbell, K. (1990). Errors and violations on the road: A real distinction. *Ergonomics, 33*(10-11), 1315–1332.

Rundmo, T. (2000). Safety climate, attitudes and risk perception in Norsk Hydro. *Safety Science*, *34*(1-3), 47-59.

Safe Work Australia (2021, December 16). *Key WHS statistics Australia 2020: Work-related injury fatalities*. https://www.safeworkaustralia.gov.au/sites/default/files/2020-11/Key%20Work%20Health%20and%20Safety%20Stats%202020.pdf

Santos, J. A., & Lu, J. L. (2016). Occupational safety conditions of bus drivers in Metro Manila, the Philippines. *International Journal of Occupational Safety and Ergonomics*, *22*(4), 508-513.

Social Security Institution (2021, December 16). *Distribution of the deceased persons due to work accident or occupational disease within year by economic activity and gender.* Under Article 4-1/a of Act 5510, SGK 2020. http://www.sgk.gov.tr/wps/portal/sgk/tr/kurumsal/istatistik/sgk_istatistik_yilliklari.

Sullman, M. J., Stephens, A. N., & Pajo, K. (2017). Transport company safety climate-the impact on truck driver behaviour and crash involvement. *Traffic Injury Prevention, 18*(3), 306-311.

Türkiye İstatistik Kurumu (2021). *Karayolu trafik kaza istatistikleri, 2020.* TUIK. https://data.tuik.gov.tr/Bulten/Index?p=Karayolu-Trafik-Kaza-Istatistikleri-2020-37436.

Useche, S. A., Cendales, B., Alonso, F., & Montoro, L. (2020). Multidimensional prediction of work traffic crashes among Spanish professional drivers in cargo and passenger transportation. *International Journal of Occupational Safety and Ergonomics*, 1-8.

Useche, S. A., Gómez, V., Cendales, B., & Alonso, F. (2018). Working conditions, job strain, and traffic safety among three groups of public transport drivers. *Safety and Health at Work, 9*(4), 454-461.

Useche, S. A., Ortiz, V. G., & Cendales, B. E. (2017). Stress-related psychosocial factors at work, fatigue, and risky driving behavior in bus rapid transport (BRT) drivers. *Accident Analysis & Prevention, 104*, 106-114.

Varonen, U., & Mattila, M. (2000). The safety climate and its relationship to safety practices, safety of the work environment and occupational accidents in eight wood-processing companies. *Accident Analysis & Prevention*, *32*(6), 761-769.

Wang, Y., Li, L., Feng, L., & Peng, H. (2014). Professional drivers' views on risky driving behaviors and accident liability: a questionnaire survey in Xining, China. *Transportation Letters, 6*(3), 126-135.

Weisstein, E. W. (2020, July 30). *Bonferroni Correction*. MathWorld-A Wolfram Web Resource. http://mathworld.wolfram.com/BonferroniCorrection.html.

Wills, A. R., Watson, B., & Biggs, H. C. (2006). Comparing safety climate factors as predictors of work-related driving behaviour. *Journal of Safety Research*, *37*(4), 375-383.

Wu, J., Yan, X., & Radwan, E. (2016). Discrepancy analysis of driving performance of taxi drivers and nonprofessional drivers for red-light running violation and crash avoidance at intersections. *Accident Analysis & Prevention, 91*, 1-9.

Yılmaz, Ş., Arslan, B., Öztürk, İ., Özkan, Ö., Özkan, T., & Lajunen, T. (2022). Driver social desirability scale: A Turkish adaptation and examination in the driving context. *Transportation Research Part F: Traffic Psychology and Behaviour, 84*, 53-64.

Yılmaz, Ş., Öz, B., & Özkan, T. Profesyonel sürücülükte sürücü davranışlarına yönelik nitel bir çalışma. *Trafik ve Ulaşım Araştırmaları Dergisi, 2*(1), 51-65.

Zohar, D. (1980). Safety climate in industrial organisations: Theoretical and applied implications. *Journal of Applied Psychology, 65,* 96-102.

Zohar, D. (2010). Thirty years of safety climate research: Reflections and future directions. *Accident Analysis & Prevention*, *42*(5), 1517-1522.

Zohar, D., Huang, Y. H., Lee, J., & Robertson, M. M. (2015). Testing extrinsic and intrinsic motivation as explanatory variables for the safety climate–safety performance relationship among long-haul truck drivers. *Transportation Research Part F: Traffic Psychology and Behaviour, 30*, 84-96.

Zohar, D., Luria, G. (2004). Climate as a social-cognitive construction of supervisory safety practices: Scripts as proxy of behaviour patterns. *Journal of Applied Psychology 89*, 322–333.