

# Investigating driving instructors: The mediating roles of driving skills in the relationship between organizational safety strategies and driver behaviours

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## A B S T R A C T

The aim of the present study is to investigate the mediating roles of driving skills in relationship between organizational safety strategies and driver behaviours among driving instructors. Driving skills consist of perceptual-motor skills and safety skills. Driver behaviours are investigated under four factors: violations, errors, lapses, and positive driver behaviours. Participants were 132 driving instructors (108 male and 24 female). In order to measure organizational safety strategies, Organizational Safety Strategies Scale (OSSS) was developed for driving schools. Results of the principal component analyses yielded one-factor solution for OSSS. In order to test the indirect effects of organizational safety strategies on driver behaviours through driving skills, multiple mediation analyses were conducted by entering age and annual mileage as the control variables. As organizational safety strategies were stronger, driving instructors had higher levels of perceptual-motor skills, which resulted in higher violations. On the other hand, as organizational safety strategies were stronger, driving instructors had higher levels of safety skills, which resulted in less violations and lapses. It can be inferred that; organizational stronger safety strategies might have negative influences on road safety through higher perceptual-motor skills; whereas there can be positive influences on road safety through higher safety skills. In addition, both skills are related to organizational safety strategies. Hence, driving schools should consider the asymmetric relationship between perceptual-motor skills and safety skills while improving their safety strategies to decrease violations and lapses. Organizations might also develop interventions to balance the stated skills to increase road safety.

### Keywords:

Driving instructors  
Driving skills  
Driver behaviours  
Safety strategies

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## 1. Introduction

According to the estimations of World Health Organization (WHO), road traffic accidents are the 8th leading cause of fatalities for all age groups (WHO, 2018). Among the causes of road traffic accidents, human factors constitute 90% of the contributing factors (Lewin, 1982; Treat et al., 1977). Hence, both human related factors and their underlying causes have

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gained attention in the literature to increase road safety. Professional drivers (i.e., people whose job is driving) have an important role in road safety since they expose to road traffic more frequently than other drivers. In addition, it is well known that, organizational perspectives on safety have influences on employees' safety related behaviours (e.g. [Amponsah-Tawiah & Mensah, 2016](#); [Caird & Kline, 2004](#)). In the current study, the aim is to investigate the mediating roles of driving skills in the relationship between organizational safety strategies and driver behaviours among driving instructors.

### *1.1. Human factors in driving*

Road traffic accidents are preventable and majority of the reasons behind them might be attributed to human error, which is considered as a sole or a contributory factor for road traffic accidents ([Lewin, 1982](#)). Driving skill/performance and driving style/behaviour are two separate components of human factors that affect how drivers behave in traffic ([Elander, West, & French, 1993](#); [Evans, 1991](#)). The way drivers prefer to drive is called driver behaviour (style). It reflects what drivers usually "do" while driving. Information processing, motor and safety skills represent driving skills (performance). They reflect what drivers "can" do and might be improved with practice and training ([Elander et al., 1993](#)).

Driver behaviours are widely measured by using the Driver Behaviour Questionnaire (DBQ). The DBQ is based on theoretical taxonomy of aberrant behaviours (i.e. violations and errors) ([Reason, Manstead, Stradling, Baxter, & Campbell, 1990](#)). Errors and violations have different psychological origins and they are distinct from each other ([Reason et al., 1990](#)). Errors are defined as "the failure of planned actions to achieve their intended consequences" ([Reason et al., 1990, p.1316](#)) and violations are defined as "deliberate deviations from those practices believed necessary to maintain the safe operation of a potentially hazardous system" ([Reason et al., 1990, p.1316](#)). Although violations and errors have different psychological origins, they are both dangerous and might cause an accident. A third factor named "slips and lapses" was also found which is about attention/memory failures and absent-mindedness, which might cause embarrassment but not pose any threat to other road users ([Parker, Reason, Manstead, & Stradling, 1995](#)).

Apart from aberrant driver behaviours that cause risky situations in traffic, there are also behaviours that aims to be helpful and polite to other road users. These behaviours are named positive driver behaviours. Positive driver behaviours are not directly related to safety. Drivers aim to take care of the traffic environment by showing positive behaviors. To measure positive driver behaviors, [Özkan and Lajunen \(2005\)](#) extended the DBQ by adding a new scale. Giving way to pedestrians, avoiding using the horn to avoid making unnecessary noise can be the examples of positive driver behaviors.

Driving skills are mainly investigated under two categories: perceptual-motor skills and safety skills. Perceptual-motor skills reflect drivers' ability in handling the car (e.g. fluent car control) and rely on information processing and motor skills. Safety skills capture drivers' attitudes and personality factors. They reflect their ability to drive in a safe manner ([Lajunen & Summala, 1995](#)). The Driver Skills Inventory (DSI) with two dimensions (i.e. perceptual-motor skills and safety skills) was developed to measure driving skills ([Lajunen & Summala, 1995](#)). To respond the items, participants are asked to rate weak and strong components of their driving skills.

Perceptual-motor skills and safety skills have different relationships with driving related variables. To illustrate, for non-professional drivers, higher levels of perceptual-motor skills are related to less frequent errors and more frequent violations. On the other hand, higher levels of safety skills are related to less frequent violations ([Öztürk & Özkan, 2018](#)). Similarly, [Martinussen, Møller, and Prato \(2014\)](#) showed that level of perceptual-motor skills had significant negative correlations with frequency of errors and lapses, and positive significant correlation with frequency of violations. Levels of safety skills had negative significant correlations with frequency of violations, errors and lapses. [Erkuş and Özkan \(2019\)](#) investigated the driving skills and driver behaviour relationships among young taxi drivers. They reported similar results for the relationship between safety skills, violations and lapses; however, for perceptual-motor skills, only its relationship with lapses was significant. Taken together, it can be inferred that, how drivers perceive their level of driving skills have effects on their reporting the frequency of aberrant behaviours both for professional and non-professional drivers.

### *1.2. Organizational safety strategies*

Compared to professional drivers, driving is a self-paced task for non-professional drivers ([Caird & Kline, 2004](#)). For instance, non-professional drivers might choose their routes among different options, but professional drivers cannot decide when and where to drive. Driving instructors form a special group of professional drivers due to characteristics of their job. Being a driving instructor requires both driving and teaching how to drive. Driver behaviours of driving instructors are important for both their own and driver candidates' safety. Driver candidates learn how to drive by practicing with their driving instructors. Hence, driving instructors can be considered as important role models for driver candidates. It can be assumed that driving instructors' driving skills and driver behaviours are affected by organizational safety practices. Organizations are complex systems with values, principles, attitudes and perspectives, which make an organization different from others ([Arnold, 2005](#)). [Zohar \(1980\)](#) defined organizational climate as "a summary of molar perceptions that employees share about their work environments" (p. 96). [Denison \(1996\)](#) stated that climate is related to how individuals perceive organizational practices. Perceptions and attitudes of employees might work as a frame of reference that guides their task behaviours. For professional drivers, it is assumed that safety policy and safety climate of an organization affect drivers' safe driving levels ([Caird & Kline, 2004](#)).

The importance of the relationship between organizational climate, and employees' performance and behaviour have been studied in the literature. [Ostrom, Wilhelmse, and Kaplan \(1993\)](#) suggested that beliefs and attitudes that are socially transmitted within the organization have effects on safety performance. The research focusing on professional organizational climate and employees' driver behaviours indicates the importance of positive climate. [Amponsah-Tawiah and Mensah \(2016\)](#) investigated the relationship between safety climate and driving behaviours among professional drivers. Results provided significant negative relationships between safety climate and driving behaviours including speeding, rule violation, inattention and driving while tired. Similarly, a study conducted with long-haul truck drivers also showed that safety climate is related to safe driving ([Zohar, Huang, Lee, & Robertson, 2015](#)). Although there are few opportunities for social-symbolic interaction with co-workers among truck drivers, climate perceptions are developed and have impacts on safety related behaviours ([Zohar et al., 2015](#)).

The studies focusing on organizational climate and using the DSI and/or the extended version of DBQ also indicate the importance of the relationship between organizational climate and driving related outcomes. [Öz, Özkan, and Lajunen \(2013\)](#) claimed that as organizations give priority to safety while arranging work load and dealing with job related time pressure, less numbers of violations and errors were reported by professional drivers. Among the driving skills, stronger general safety management was related to higher levels of safety skills. A study conducted among truck drivers also provided similar results for aberrant driver behaviors, showing significant negative relationships between safety climate, frequency of violations and errors/lapses ([Sullman, Stephans, & Pajo, 2016](#)). Similar to truck drivers, driving instructors must comply with the rules and regulations of the organization and they also work away from the organization; however, driving instructors have more opportunities to communicate with their organizations than truck drivers have. In addition to communication within the organization, the interventions to improve safety that are provided by the driving schools might strength organizational safety strategies, which are assumed to affect driving skills and driver behaviours of driving instructors.

### 1.3. Aim of the study

Driving skills and driver behaviors of non-professional drivers are influenced by several factors such as age, exposure, and personality. In addition to the stated variables, organizational safety practices are among the factors that may influence the driving related skills and behaviors of professional drivers. Previously, safety practices of organizations and their relationships with driving skills and driver behaviors were studied separately. The current study aims to investigate the mediating role of driving skills in the relationship between organization's safety strategies and driver behaviors among driving instructors.

## 2. Method

### 2.1. Sample and procedure

132 driving instructors participated to the current study (Female = 24; Male = 108). The mean age of driving instructors was 43.98 years ( $SD = 9.74$ ), and the average mileage for the last year was 36311 km ( $SD = 43422.90$  km). The average years driven was 21.14 ( $SD = 8.80$ ) and the average year being a driving instructor was 8.12 ( $SD = 6.09$ ).

The majority of the data was collected in Ankara, the capital city of Turkey. To collect data, contact information of driving schools was obtained via internet and they were listed based on their locations. Once contacted with a driving school, the permission was received from course director. After getting permission from the course directors, driving instructors were asked personally to complete the questionnaires if they accept to participate to the present study. All the participants were informed about anonymity and confidentiality of the data collection procedure.

### 2.2. Measures

#### 2.2.1. Organization's Safety Strategies Scale (OSSS)

The OSSS was developed to measure an organization's (i.e. driving school) safety strategies. The items of OSSS are about the extent that organization give importance on safety strategies by driving instructors' development, support their needs, and monitoring the education system regularly. The participants were asked to evaluate items on a 6-point Likert type scale (1 = strongly disagree, 6 = strongly agree). In the current study, Cronbach's Alpha for internal consistency score was 0.94. High scores obtained from OSSS indicate stronger safety strategies and low scores indicate weaker safety strategies of an organization.

To develop the OSSS, a literature search was conducted to find out the studies on driving instructors and also studies investigated attitudes of employees towards safety strategies. Additionally, semi-structured preliminary interviews were conducted with driving instructors, directors/owners of driving schools. The semi-structured interview forms included questions about the main tasks, characteristics, best and worst parts, and working conditions, job related needs of driving instructors. Besides, their ideas to make their profession and working conditions better were asked. In total, 26 driving instructors (Female = 2; Male = 24) and 8 director/owner of driving schools participated to the interviews. The mean age of driving instructors was 38.12 ( $SD = 7.78$ ) and the average years of being a driving instructor was 6.62 ( $SD = 3.83$ ). The means age

of director/owner of driving schools was 40.88 ( $SD = 6,24$ ) and the average years of being a director/owner was 5.88 ( $SD = 3,56$ ). After the interviews, items were developed or adapted under related scales by the project researchers. After listing the items, a panel was conducted with the same people who took part in the interviews to discuss the items. The interviewees were asked to add new items if they think they are necessary. In total, 49 items were developed.

### 2.2.2. The Driver Behaviour Questionnaire (DBQ)

The extended version of the DBQ (Parker, McDonald, Rabbitt, & Sutcliffe, 2000) with Positive Driver Behaviour Scale (Özkan & Lajunen, 2005) was used in the present study. The scale measures the frequency of driver behaviours. DBQ includes three dimensions: violations, errors and lapses. Each item was evaluated on a 6-point Likert type scale (1 = never, 6 = always). The Cronbach's Alpha internal consistency scores of the violations (12 items), errors (8 items), lapses (8 items) and positive driver behaviours (14 items) scales for the present study were 0.83, 0.70, 0.75 and 0.90, respectively. Higher scores obtained from the DBQ represent higher frequency of the given driver behaviours.

### 2.2.3. The Driving Skills Inventory (DSI)

The DSI measures the perceived driving skills of drivers. Twenty-item version of the DSI was developed by Lajunen and Summala (1995). Participants completed the questionnaire on a 5-point Likert-type scale (0 = very weak; 4 = very strong). The scale includes two dimensions, which are perceptual-motor skills (11 items) and safety skills (9 items). In the present study, the Cronbach's Alpha for internal consistency score was 0.87 for perceptual-motor skills and was 0.84 for safety skills. Higher scores obtained from the DSI represent higher levels of perceptual-motor and safety skills.

## 3. Results

The data were checked for outliers before statistical analyses. First, exploratory factor analysis was conducted to figure out the factor structure of the OSSS. Second, Pearson correlation was conducted to investigate the associations between the study variables. To test the mediating roles of driving skills between organizational safety strategies and driver behaviours, parallel multiple mediation analyses were conducted by using Hayes PROCESS tool extension on SPSS (Hayes, 2013).

### 3.1. Exploratory factor analysis

Principal component analysis with a forced one-factor solution was performed for 49 items. The scree plot results also supported one-factor solution. The cut-off score of factors loading value was determined as 0.40. The items loaded to the factor with a value of higher than 0.40 were included into that factor. The factor explained 26.34 of the total variance with an eigenvalue of 12.91. After application of one-factor solution with 0.40 cut-off, the 34-item scale was obtained (see Table 1).

### 3.2. Correlation analyses

Among the study variables, age was positively related to organizational safety strategies ( $r = 0.26, p < .01$ ), safety skills ( $r = 0.19, p < .05$ ), and negatively related to frequency of violations ( $r = -0.31, p < .01$ ). Organizational safety strategies were positively related to perceptual-motor skills ( $r = 0.31, p < .01$ ) and safety skills ( $r = 0.48, p < .01$ ); and negatively related to frequency of violations ( $r = -0.19, p < .05$ ) and lapses ( $r = -0.25, p < .01$ ). Perceptual-motor skills were positively related to safety skills ( $r = 0.67, p < .01$ ) and positive driver behaviours ( $r = 0.19, p < .05$ ), and negatively related to errors ( $r = -0.36, p < .01$ ), frequency of violations ( $r = -0.28, p < .01$ ), and lapses ( $r = -0.46, p < .01$ ). Safety skills were positively related to positive driver behaviours ( $r = 0.20, p < .05$ ), and negatively related to errors ( $r = -0.32, p < .01$ ), frequency of violations ( $r = -0.50, p < .01$ ) and lapses ( $r = -0.51, p < .01$ ). Frequency of errors were positively related to frequency of violations ( $r = 0.62, p < .01$ ) and lapses ( $r = 0.72, p < .01$ ). Frequency of violations was positively related to lapses ( $r = 0.68, p < .01$ ). The correlation coefficients among study variables are presented in Table 2.

### 3.3. Multiple mediation analyses

The indirect effects of organizational safety strategies on driver behaviours through driving skills were tested via bootstrapping indirect paths method (Hayes, 2013; Preacher & Hayes, 2008). SPSS Indirect Macros (Preacher & Hayes, 2008) were used to conduct multiple mediation analyses. In all analyses, age and annual mileage were entered as control variables. For each dependent variable (i.e. errors, violations, lapses, and positive driver behaviours), multiple mediation analyses were conducted separately. The results were significant only for violations and lapses.

#### 3.3.1. Organizational safety strategies, driving skills and violations

The total indirect effect of organizational safety strategies on frequency of violations through all mediators ( $B = -0.11, SE = 0.04$ ) was significant since the bias corrected confidence intervals did not include zero ( $LLCI = -0.21; ULCI = -0.04$ ) (Tables 3 and 4). First, as organizational safety strategies were stronger, driving instructors reported higher levels of

**Table 1**  
Factor structure of OSSS.

	Factor loadings	ITC
Driving instructors teach all types of safe driving related knowledge and skills to the driver candidates even if this information is not included in the curriculum	0.510	0.413
Management periodically evaluates driving instructors	0.707	0.639
Management takes the driving instructor's needs and suggestions into account while improving the training methods	0.599	0.561
The importance of driving respectfully is highlighted to driver candidates	0.504	0.435
The driver candidates are thought what they should <b>legally</b> do in case of an accident	0.438	0.416
The curriculum applied for driving practice training is enough to teach the driver candidates drive safely	0.406	0.376
Management asks all driving instructors to work in interaction with other instructors for a better driving practice training	0.628	0.570
Management asks driving instructors to take the candidates' current mood, personality and learning style into account while giving driving practice training	0.663	0.611
Driving instructors provide the driver candidates with adequate theoretical knowledge during driving practice training	0.513	0.442
Driving background of the driving instructors (e.g., number of penalties, accident involvement, driving experience) are taken into account during recruitment and selection process	0.546	0.493
Before they start to give driving practice training to driver candidates, driving instructors are given a separate orientation/training	0.434	0.408
Management gives guidance to the driving instructors how to communicate with driver candidates during the course	0.535	0.499
Driver candidates are taught to drive according to the rules and regulations regarding to the main problems of traffic (e.g., speeding, close following, faulty overtaking, drunk driving)	0.469	0.397
Technical improvements, methods and rules related to driving practice training are forwarded to driving instructors	0.675	0.619
Regardless of how seriously the driver candidate takes the driving training, all driving instructors treat each candidate at the same level of seriousness	0.698	0.662
The driving practice training sites are chosen so that they reflect great variety of traffic conditions	0.685	0.621
Driver candidates are informed about how to behave under undesired conditions in traffic settings (e.g., anger, aggression, harassment in traffic)	0.649	0.614
Management choose driving instructors by considering their education level	0.539	0.501
Driver candidates take a different practical training for different classes of driver licenses	0.569	0.513
Experienced driving instructors help and guide the new hired driving instructors when they ask for	0.603	0.553
Management supports driving instructors to make them gain professional/job related belongingness	0.715	0.676
Management regularly informs the driving instructors about the new developments of in-vehicle technologies	0.743	0.707
Management provides information and assistance to the driving instructors to help them to improve themselves in their profession	0.771	0.739
Even if the driving lessons in the curriculum are completed, driver candidates who seem inadequate are called for additional lessons	0.606	0.569
A satisfactory wage policy is applied to keep the quality of driving instructors high	0.471	0.416
Management helps driver candidates in driving related problems even after they take their driving license	0.582	0.542
Management organizes meetings where driving instructors can share the driver training related problems with each other and be aware of their own job related strong and weak aspects by getting feedback from other driving instructors	0.752	0.742
The practice sessions are done in the fast traffic.	0.428	0.385
Driver candidates are taught how to drive under risky times, situations and weather conditions	0.592	0.511
Management gives some sorts of feedback and necessary guidance to driving instructors for a better driving practice training	0.679	0.661
Pedagogical knowledge of driving instructors is updated regularly	0.506	0.485
The primary aim in driving practice training is to make the driver candidate ready to drive in real traffic settings as a safe driver	0.477	0.433
Driver candidates are given a training that provides an objective awareness about their knowledge, skills and abilities	0.578	0.560
The training is based on the idea that a complete learning is achieved by life-long and continuous education, not by teaching the basic principles of driving for once	0.655	0.623

\*ITC: Item-total correlation.

**Table 2**  
Means, standard deviations and correlations among study variables.

	Mean	SD	1	2	3	4	5	6	7	8
1. Age	43.98	9.73	1							
2. Annual km	36311.51	43422.90	-0.03	1						
3. OSS	4.55	0.82	0.26**	0.01	1					
4. PMS	4.40	0.46	0.07	0.17	0.31**	1				
5. SS	4.29	0.49	0.19*	0.24**	0.48**	0.67**	1			
6. Errors	1.29	0.39	-0.17	-0.10	-0.15	-0.36**	-0.32**	1		
7. Violations	1.48	0.48	-0.31**	-0.06	-0.19*	-0.28**	-0.50**	0.62**	1	
8. Lapses	1.36	0.38	-0.16	-0.11	-0.25**	-0.46**	-0.51**	0.72**	0.68**	1
9. Positive behaviours	4.39	1.07	0.14	0.09	0.17	0.19*	0.20*	-0.16	-0.06	-0.02

Note: OSS: Organizational Safety Strategies; PMS: Perceptual-Motor Skills; SS: Safety Skills.

\*\* p < .01.

**Table 3**  
Results of Bootstrap: Indirect effects in Multiple Mediation Model 1.

Indirect Effect	Coefficient	Point estimate	Bias	SE	95% Bias Corrected Confidence Intervals	
					Lower	Upper
Total	-0.11	-0.11	-0.0008	0.04	-0.21	-0.04
PMS	0.05	0.05	-0.0004	0.04	0.01	0.16
SS	-0.16	-0.16	-0.0004	0.05	-0.28	-0.08

Note: IV: Organizational Safety Strategies; DV: Violations; M: PMS (Perceptual-Motor Skills) & SS (Safety Skills).

**Table 4**  
The Summary of the Findings for Model.

Independent Variable	Mediator	Dependent Variable	Mediation	Confidence Interval
OSS	Perceptual-motor skills	Violations	Yes	Significant
OSS	Safety skills	Violations	Yes	Significant

Note: OSS: Organizational Safety Strategies.

perceptual-motor skills ( $a_1 = 0.19, p < .001$ ), which in turn increased the frequency of violations ( $b_1 = 0.26, p < .05$ ). Second, as organizational safety strategies were stronger, driving instructors also reported higher levels of safety skills ( $a_2 = 0.27, p < .001$ ), which in turn decreased the frequency of violations ( $b_2 = -0.60, p < .001$ ) (Fig. 1). The indirect effect was calculated based on the 1000 bootstrap samples.

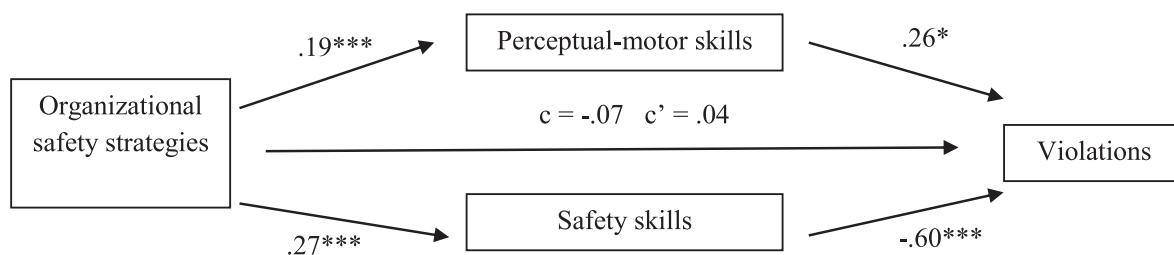
### 3.3.2. Organizational safety strategies, driving skills and lapses

The total indirect effect of organizational safety strategies on lapses through all mediators ( $B = -0.09, SE = 0.03$ ) was significant since the bias corrected confidence intervals did not include zero ( $LLCI = -0.17; ULCI = -0.04$ ) (Tables 5 and 6). Among mediators (i.e. perceptual-motor skills and safety skills), only safety skills mediated the relationship between organizational safety strategies and lapses. As organizational safety strategies were stronger, driving instructors reported higher safety skills ( $a_2 = 0.27, p < .001$ ), which in turn decreased the frequency of lapses ( $b_2 = -0.26, p < .05$ ) (Fig. 2). The indirect effect was calculated based on the 1000 bootstrap samples.

## 4. Discussion

The majority causes of the road traffic accidents are related to human factors. In order to decrease road traffic accidents and undesired outcomes, it is important to examine the possible underlying causes of human factors. Among professional drivers, the relationships between organizational perspectives on safety (e.g. safety strategies, safety climate), their influences on driving skills and driver behaviors have been studied before. In the current study, the mediating role of driving skills in the relationship between organizational safety strategies and driver behaviors among driving instructors are studied for the first time in the literature.

The OSSS was developed to measure organizational safety strategies of driving schools and results of the principal component analyses yielded one-factor solution. In order to investigate the mediating roles of driving skills in the relationship between organizational safety strategies and driver behaviours among driving instructors, several multiple mediation analyses were conducted. The results showed that both perceptual-motor skills and safety skills mediated the relationship between organizational safety strategies and frequency of violations and only safety skills mediated the relationship between organizational safety strategies and frequency of lapses. More specifically, as an organization had stronger safety strategies, driving instructors had higher levels of perceptual-motor skills, which resulted in higher violations. Whereas,



**Fig. 1.** The path model (Model 1) and unstandardized regression coefficients indicating perceptual-motor skills and safety skills as the mediators of the relationship between organizational safety strategies and violations.

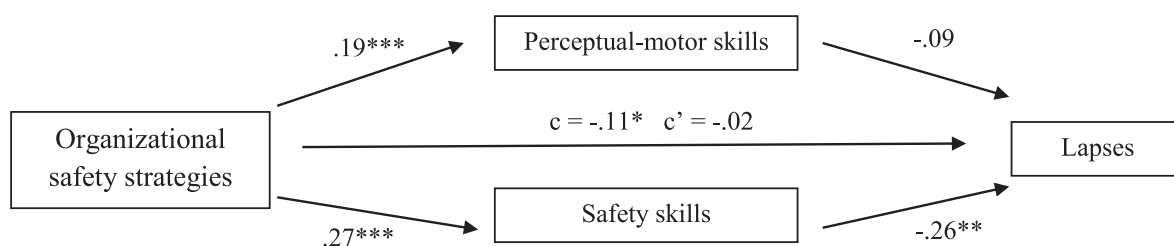
**Table 5**  
Results of Bootstrap: Indirect Effects in Multiple Mediation Model 2.

Indirect Effect	Coefficient	Point estimate	Bias	SE	95% Bias Corrected Confidence Intervals	
					Lower	Upper
Total	-0.09	-0.09	0.0002	0.03	-0.17	-0.04
PMS	-0.02	-0.02	0.0003	0.02	-0.06	0.02
SS	-0.07	-0.07	0.0001	0.03	-0.14	-0.03

Note: IV: Organizational safety strategies; DV: Lapses; M: PMS (Perceptual-Motor Skills) & SS (Safety Skills).

**Table 6**  
The Summary of the Findings for Model 2.

Independent Variable	Mediator	Dependent Variable	Mediation	Confidence Interval
Organizational safety strategies	Perceptual-motor skills	Lapses	No	Non-significant
Organizational safety strategies	Safety skills	Lapses	Yes	Significant



**Fig. 2.** The path model (Model 2) and unstandardized regression coefficients indicating perceptual-motor skills and safety skills as the mediators of the relationship between organizational safety strategies and lapses.

as an organization had stronger safety strategies, driving instructors had higher levels of safety skills, which resulted in less frequent violations and lapses. In general, the relationship between organizational safety strategies and related outcomes were significant, which is in line with some earlier findings (e.g. Antonsen, 2009; Guldendum, 2010). Although there are other factors that affect human factors (e.g. personality, personal attitudes, physical environment), it is plausible to suggest that organizational safety strategies of driving schools also have influences on driving instructors' driving skills and driver behaviors.

The findings of the current study suggested an asymmetric relationship between perceptual-motor skills and safety skills in relation to violations. In the literature, studies also reported an asymmetric relationship between levels of perceptual-motor skills and safety skills in relation to frequency of driving related risky behaviours, penalties, and accidents (Lajunen, Parker, & Stradling, 1998; Sümer, Özkan, & Lajunen, 2006). To illustrate, higher levels of perceptual-motor skills were associated with higher number of penalties whereas higher safety skills were related to lower number of penalties (Sümer et al., 2006). Drivers might evaluate themselves better than average for driving skills (Delhomme, 1996; McCormick, Walkey, & Green, 1986, McKenna, Stanier, & Lewis, 1991). Hence, it can be claimed that, the positive relationship between perceptual-motor skills and aberrant driver behaviours might be riskier for road safety. Due to overestimation of perceptual-motor skills, risky behaviours show an increase, but safety skills might make drivers more cautious and play as a buffer to decrease the negative effects of overestimation in driving skills (Sümer et al., 2006). Since the drivers' attitudes toward safety in traffic are based on the balance between perceptual-motor skills and safety skills, the distinction between the two driving skills has been highlighted (e.g. Lajunen et al., 1998; Özkan, Lajunen, Chliaoutakis, Parker, & Summala, 2006). Also, it is claimed that, the internal balance between perceptual-motor skills and safety skills is important to decrease risky situations (Lajunen et al., 1998). The findings of the current study support this claim. Hence, driving schools should consider the asymmetric relationship between perceptual-motor skills and safety skills while improving their safety strategies. Organizations might also develop interventions to balance the stated skills to increase road safety.

The mediating role of safety skills in the relationship between organizational safety strategies and lapses was significant. As organizational safety strategies were stronger, driving instructors reported higher levels of safety skills, which resulted in less frequency of lapses. Lapses are about attention and memory failures (Reason et al., 1990). Stronger organizational safety strategies might be helpful for driving instructors by improving their safety skills, that is important to keep attention and concentrate on driving. Considering the related literature for professional drivers, the number of studies focusing on the driving skills and driver behaviours relationship is limited. Besides, the relationships also have different patterns among different professional driver groups. For instance, in a study conducted with Chinese bus drivers, safety motives (which can be considered as safety skills in the current study) were related to both errors and lapses (Zhang, Ma, Ji, Hu, & Zhu, 2019). In another

study conducted with professional drivers, none of the driving skills had significant relationships with errors (Öz et al., 2013). The current study shows both the direct effects of safety skills and indirect effects of organizational safety strategies on errors for driving instructors. Hence, it can be claimed that, stated relationships should be studied for separately for different groups of professional drivers in order to develop profession-specific interventions for increasing road safety.

The results showed that driving skills do not mediate the relationship between organizational safety strategies and errors. In the literature, there are studies that examined the work-related variables and frequency of errors and reported significant associations. To illustrate, professional drivers report less numbers of errors and violations when they perceive their company as arranging their work load and dealing with time pressure (Öz et al., 2013). Similarly, organizational safety climate was found as closely related to frequency of errors and violations (Öz, Özkan, & Lajunen, 2013). Although driving instructors might be a subgroup of professional drivers, it might be inferred that, the relationships between organizational safety strategies, driving skills and behaviours show differences as compared to other professional driver groups (e.g. bus drivers, truck drivers). The differences between the professional driver groups might be due to several reasons. First, the driving instructors might have different patterns than other professional driver groups since the nature of their job is different. Driving instructors drive frequently, mainly on urban roads rather than county roads. In addition, they drive and teach at the same time, which is the most important feature that distinguishes driving instructors from other professional driver groups. This feature might also require divided-attention skills, which can be investigated in future research. Second, the specificity level of safety perspectives used in the literature and the current research might show variance. In other words, the OSSS might not be as subject specific as in previous studies (e.g. work orientation, safety climate).

Similarly, the multiple mediation analyses did not reveal significant results for the mediating roles of driving skills in the relationship between organizational safety strategies and positive driver behaviours. Positive driver behaviours are not directly related to safety, but they are about being polite and helpful to other road users (Özkan & Lajunen, 2005). Previously, the studies included both professional and non-professional drivers could not provide significant results for the relationship between driving skills and positive driver behaviours (e.g. Öz et al., 2010; 2013). Mahembe and Samuel (2016) conducted a study with taxi drivers and found significant relationships with conscientiousness, agreeableness and fatalism and frequency of positive driver behaviours. Hence, it might be suggested that personality might have effects on positive driver behaviours rather than driving skills since they are not directly related to safety.

The first limitation of the present study is about the sample size, which is relatively low for exploratory factor analysis. In future studies, the factor structure of the OSSS can be re-evaluated with larger samples. In addition, the sample size for multiple mediation analyses might not be ideal; however, this limitation was overcome by using bias corrected bootstrapping to test the significance by confidence intervals. Using self-report instruments might be another limitation. Although the DSI is a widely used self-report instrument to measure driving skills, it measures driver's skill and safety orientation rather than actual driving skills (Lajunen & Özkan, 2011). The similar problem can be also stated for the DBQ. The participants may not remember the frequency of their behaviours accurately. In future studies, psychotechnical instruments and driving simulators can be included as objective measures. Lastly, although the OSSS is developed specifically for driving schools, the DSI and the DBQ are scales that are designed for non-professional drivers' daily driving environments. In future studies, new scales that measure driving skills and driver behaviours that focus on driving instructors might be developed.

## 5. Conclusion and implications

Human factors are the major causes of road traffic accidents and fatalities. To avoid the undesired outcomes in road safety, investigating underlying factors of driving skills and driver behaviours are important. For professional drivers, organizational perspectives on safety is among the variables that are related to human factors. In the literature, the stated variable were studies for professional groups; however, the current research is the first study that investigated the mediating role of driving skills in the relationship between organizational safety strategies and driver behaviours among driving instructors. Similar to the results of the literature, it can be claimed that organizational safety practices have influences on driver behaviours. In addition, the stated relationship is mediated by driving skills. The current study highlights the asymmetric relationship between perceptual-motor skills and safety skills on driver behaviours. Stronger organizational safety strategies might cause an increase in the frequency of violations through higher perceptual-motor skills. On the other hand, they might decrease the frequency of violations and lapses through safety skills. Driving schools can consider the importance of balance between perceptual-motor skills and safety skills while developing their safety strategies. Overestimation of perceptual-motor skills is also a problem for road-safety since it is related to higher aberrant driver behaviours (Sümer et al., 2006). In addition to safety strategies, driving schools can develop interventions for driving instructors to objectively evaluate their perceptual-motor skills. These interventions might be helpful for driving instructors to show less aberrant driver behaviours.

## CRedit authorship contribution statement

**Yeşim Üzümcüoğlu:** Conceptualization, Formal analysis, Writing - original draft. **Bahar Öz:** Methodology, Conceptualization, Investigation, Writing - original draft. **Türker Özkan:** Methodology, Conceptualization, Investigation, Writing - review & editing. **Timo Lajunen:** Project administration, Methodology, Conceptualization, Supervision, Funding acquisition.



## Acknowledgment

This study was supported by Lifelong learning programme LEONARDO DA VINCI (LLP-LdV-TOI-2007-TR-008).

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