PREFERRED LEVEL OF VEHICLE AUTOMATION IN TURKEY AND SWEDEN: IN ASSOCIATION WITH TRAFFIC CLIMATE, TRAFFIC LOCUS OF CONTROL AND DRIVING SKILLS

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ABSTRACT

PREFERRED LEVEL OF VEHICLE AUTOMATION IN TURKEY AND SWEDEN: IN ASSOCIATION WITH TRAFFIC CLIMATE, TRAFFIC LOCUS OF CONTROL AND DRIVING SKILLS

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With technological developments, vehicles with different capabilities are becoming part of the traffic system. In recent years, vehicles with different levels of automation are taking the attention of both industry and academia. In addition, traffic climate, traffic locus of control and driving skills have been related to various road safety outcomes such as accidents. The present study examines how traffic climate, traffic locus of control and driving skills are related to drivers' automated vehicle preference. A total of 318 drivers (M = 22.41, SD = 2.77) from Turkey and 312 drivers (M = 28.80, SD = 8.53) from Sweden participated in the study. Participants completed a questionnaire package including demographic information form with the preferred level of automation question, Traffic Climate Scale, Multidimensional Traffic Locus of Control Scale and Driving Skills Inventory. Male drivers, compared to female drivers, and drivers from Turkey, compared to drivers from Sweden, preferred vehicles with higher levels of automation. Furthermore, automation preference was associated positively with functionality and safety skills in Turkey and own skills in Sweden and negatively with perceptual-motor skills in both countries and other drivers in Sweden. Additionally, external affective demands and functionality showed three-way interactions. For example, when the external affective demands were perceived to be high in Sweden, drivers with higher safety skills or vehicle and environment attribution preferred higher levels of automation. The results presented some crucial findings in relations to future of the automated vehicles. In light of the current literature, further implications of the findings were discussed.

Keywords: preferred level of vehicle automation, traffic climate, traffic locus of control, driving skills

ÖZ

TÜRKİYE VE İSVEÇ'TE TERCİH EDİLEN ARAÇ OTOMASYON SEVİYESİ: TRAFİK İKLİMİ, TRAFİK KONTROL ODAĞI VE SÜRÜŞ BECERİLERİ İLE İLİŞKİSİ

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Teknolojik gelişmelerle birlikte farklı özelliklere sahip araçlar trafik sisteminin birer parçası olmaktadır. Son yıllarda farklı seviyelerde otomasyon özelliği olan araçlar hem endüstrinin hem de akademinin dikkatini çekmektedir. Buna ek olarak, trafik iklimi, trafik kontrol odağı ve sürüş becerileri sürücü davranışları ve kazalar gibi birçok yol güvenliği çıktısıyla ilişkili bulunmuştur. Mevcut çalışma trafik iklimi, trafik kontrol odağı ve sürüş becerilerinin sürücülerin otonom araç tercihleriyle ilişkisini incelemektedir. Çalışmaya Türkiye'den 318 (*Ort.* = 22.41, *SS* = 2.77) ve İsveç'ten 312 (*Ort.* = 28.80, *SS* = 8.53) sürücü katılmıştır. Katılımcılar, tercih edilen araç otomasyonu sorusunu da içeren demografik bilgi formu, Trafik İklimi Ölçeği, Çok Boyutlu Trafik Kontrol Odağı Ölçeği ve Sürüş Becerileri Ölçeği'nden oluşan bir ölçek bataryası doldurmuşlardır. Kadın sürücülere kıyasla erkek sürücüler ve İsveç'teki sürücülere kıyasla Türkiye'deki sürücüler daha yüksek seviyelerdeki otonom araçları tercih etmiştir. Ayrıca, otomasyon tercihleri Türkiye'de işlevsellik ve güvenlik becerileriyle ve İsveç'te kendi becerileri ile pozitif ilişki gösterirken her iki ülkede de algısal-motor becerilerle ve İsveç'te diğer sürücüler ile negatif ilişkilidir. Ek olarak, dışsal duygu talepleri ve işlevsellik üçlü etkileşim etkisi göstermiştir. Örneğin, İsveç'te dışsal duygu talepleri yüksek algılandığında güvenlik becerileri veya araç ve çevre atfı yüksek sürücüler daha yüksek seviyelerde otonom araçları tercih etmektedir. Sonuçlar otonom araçların geleceğiyle ilgili bazı önemli bulgular sunmaktadır. Bulguların ileri uygulamaları mevcut alanyazın ışığında tartışılmıştır.

Anahtar Kelimeler: tercih edilen araç otomasyonu seviyesi, trafik iklimi, trafik kontrol odağı, sürüş becerileri

“Difficult to see. Always in motion is the future.” – Yoda
Star Wars: Episode V - The Empire Strikes Back

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

According to the latest Global Status Report on Road Safety of the World Health Organization (WHO, 2018), road traffic accidents are one of the crucial public health problems all over the world. These accidents are the eighth leading cause of death for all age groups and the first leading cause of death for people between five and 29 years. Overall, for all age groups, these accidents result in 1.35 million deaths each year. The statistics indicated that, from the previous report on road safety in 2015, the number of deaths increased from 1.25 million to 1.35 million. The age range in which road traffic accidents were the leading cause of death extended from 15-29 to 5-29 (WHO, 2015; 2018). Considering the impact of road traffic accidents, studies associated with road safety correspond to great importance. In recent years, automated vehicles (AV) and driving have been one of the salient topics in transportation studies. With the technological developments, automated vehicles propose a significant potential to decrease undesirable driving outcomes such as accidents, injuries and deaths (Chan, 2017). Concerning these, it would be essential to examine how the public approaches automated vehicles and how different factors associated with road safety are related to attitudes of drivers toward automated vehicles. Following this, the present thesis focuses on drivers' preferred level of vehicle automation and how different factors are related to that preference. More specifically, the relations of traffic climate, traffic locus of control and driving skills with the preferred level of vehicle automation of drivers from Turkey and Sweden were investigated.

1.1. Automated Driving and Road Users' Acceptance

The SAE International Standard J3016 differentiated six levels of driving automation, namely, Level 0: No automation, Level 1: Driver assistance, Level 2: Partial automation, Level 3: Conditional automation, Level 4: High automation and Level 5: Full automation. These levels mainly differ in terms of two components as the dynamic driving sub-tasks and the functional capability of vehicles. As the level increases, the automated system is more able to support dynamic sub-tasks and search and act in a broader driving environment. No automation means that drivers perform all driving tasks. In driver assistance, the majority of the driving tasks are still completed by the driver, but some assisting features are presented. For partial automation, some of the functions such as acceleration and steering are done automatically, but the driver must always control the environment and remain engaged. Conditional automation means that the system performs some of the driving tasks, but the driver should be present and ready to take control of the vehicle in case of an emergency. In high automation, the system is able to function under certain driving conditions, and the driver is not required but can operate manually. At the final level, full automation, all driving tasks are performed by the autonomous system, and the driver only enters the destination (SAE, 2016).

In one study, Chan (2017) identified various benefits of automated driving systems for drivers, traffic system and society. For instance, automated systems promise fewer road traffic accidents and a less demanding traffic environment for drivers. For traffic system, more accessible, more efficient infrastructure and more effective transportation are expected. Moreover, from a societal perspective, automated vehicles may reduce accidents and costs due to these accidents and result in environment and public friendly transportation (Chan, 2017). Alessandrini et al. (2015) also discussed that automated vehicles would have various benefits for road safety, such as environmental benefits, benefits for older and disabled road users, being efficiently integrated with cyclists and pedestrians.

As discussed by Nordhoff et al. (2016), studies related to the acceptance of automated vehicles have significant importance because the level of acceptance is an antecedent of whether the system will be successfully implemented and used by road users. Various studies have been examined the differences in road users’ attitudes and intentions to use different levels of automated vehicles (Buckley et al., 2018; Hohenberger et al., 2016; Madigan et al., 2017). These studies also used different models such as the Theory of Planned Behavior (Ajzen, 1991) with attitudes toward a behaviour, subjective norms, perceived behavioural control and intention constructs and the Technology Acceptance Model (Davis, 1989) with perceived usefulness and perceived ease of use constructs in the study of Buckley et al. (2018) and the Unified Theory of Acceptance and Use of Technology (Hartwich et al., 2019; Madigan et al., 2017) with performance expectancy, effort expectancy, social influence and facilitating conditions constructs developed by Venkatesh et al. (2003).

In the study of Buckley et al. (2018), constructs of the Theory of Planned Behaviour were significantly and positively related to intention to use AV Level 3. Positive attitudes toward the behaviour, subjective norms and perceived behavioural control were also associated with higher intention to use AV Level 3. In addition to the Theory of Planned Behaviour constructs, trust was also significantly associated with intention. Higher trust in the Level 3 automated vehicles was related to higher intention to use automated vehicles. Moreover, Buckley et al. (2018) also tested the Technology Acceptance Model constructs as perceived usefulness and perceived ease of control in addition to the Theory of Planned Behaviour. Contrary to perceived ease of use, perceived usefulness was positively associated with the intention to use AV Level 3. Similarly, trust also showed significant and positive relations to the intention to use AV Level 3.

Considering the age and sex differences in the attitudes and intentions toward different levels of automated vehicle, there have been some contradictory findings. For instance, Buckley et al. (2018) did not find any significant relations between age, gender and the intention to use automated vehicles. Moreover, Hartwich et al. (2019) also found no effect of age on highly automated driving acceptance or trust. However, they also found that older driver exhibited more positive attitudes towards using highly automated driving. On the other hand, Schoettle and Sivak (2014) also found that young participants were more positive toward connected vehicles. Nordhoff et al. (2019) discussed that the effects of gender and age were weaker or even disappeared after introducing other factors. In addition to age and sex, Syahrivar et al. (2021) also found associations between driving frequency, experience and automated vehicle preference. In Hungary, drivers with higher driving frequency and driving experience preferred vehicles with lower levels of automation.

In another study, Qu et al. (2019) investigated drivers' and non-drivers' acceptance of autonomous vehicles. The factors related to acceptance were constructed under four dimensions, namely benefits in usefulness, concern scenarios, benefits in situation, and system concern. Age was positively correlated with benefits in usefulness and negatively correlated with concern scenarios and system concern. On the other hand, being male is positively related to benefits in usefulness. Moreover, compared to non-driver road users, drivers had more positive attitudes, rated autonomous systems more useful and had fewer concerns about the autonomous systems (Qu et al., 2019). In another study, Hohenberger et al. (2016) found that male drivers were more likely to used automated vehicles than female drivers. Similarly, Schoettle and Sivak (2014) also found that even though the majority of the participants believed that automated vehicles could decrease the number of accidents, females had higher concerns related to learning using connected vehicles. Similarly, Hulse et al. (2018) also found that male drivers and young drivers were more likely to have positive attitudes toward autonomous vehicles.

Lodinger and DeLucia (2019) indicated that, compared to manual driving, automated driving resulted in better time-to-collision judgements. It was discussed that automated driving allowed drivers additional free cognitive resources to be used to screen visual information, and that resulted in better time-to-collision judgements. It was also found that drivers showed faster breaking reactions to the decelerating lead vehicle while driving in automated mode than manual mode. Cunningham et al. (2019) found that the strongest benefit of automated vehicles was being safer than non-automated vehicles. According to the study of Wang et al. (2020), one of the critical points regarding connected and automated vehicle technologies is to determine the effects of each technological development on accident prevention. The meta-analysis conducted by Wang et al. (2020) showed that different technologies associated with connected and automated vehicles had different effects on various forms of traffic accidents. For example, for rear-end accidents, automated emergency breaking was more effective than adaptive cruise control. Overall, based on the data coming from six countries, it was estimated that equipping vehicles with connected and automated technologies could reduce the number of accidents by 47.48%.

Even though there have been studies indicating the safety benefits of automated vehicles, different studies also presented some critical issues. Noy et al. (2018) discussed several safety benefits and concerns of automated driving. For instance, with automated driving, driver error interpretation will change. Moreover, automated driving needs complex algorithms, and there are various cases of road traffic accidents. Inappropriate algorithms or software failures may result in more accidents indicating a new category of road traffic accidents. It was concluded that the overall effects of automated driving on road safety depend on various improvements. Besides, one of the safety-critical issue related to automated vehicles is the take-over request (Noy et al., 2018). In other words, at certain levels, such as highly automated driving, an automated system needs to give control of the vehicle to the driver under certain situations. Brandenburg and Chuang (2019) studied the take-over request at highly automated vehicles and found that take-over request should be context-sensitive. It was also found that headway-time should be high enough. In another study conducted by Pradhan et al. (2018), some concerns of the participants regarding ADAS were discussed. For instance, even though benefits for novice and older driver were expected, overreliance on the system, technological failures, being overwhelmed by technology or distractions were commonly reported concerns.

In another study, Wandtner et al. (2018) found that drivers engaged in more secondary tasks in highly automated driving than manual driving. Moreover, as highlighted by Jeong et al. (2017), automated vehicles will not be the single form of vehicles on the road in the near future, so the transition to vehicles of this level will be gradual. Similar to Noy et al. (2018), Winkle (2016) also discussed the benefits and risks of full automation. For instance, even though human error will become zero with full automation, technical failures will become a new risk group indicating a shift from human error to technical failures in terms of the reasons for road traffic accidents. In another study, Hagl and Kouabenan (2020) found that driving with advanced driver-assistance systems, a low level of automation resulted in increased perception of control over risks and decreased perception of being involved in accidents because of risky behaviours.

Previous studies also showed cross-country differences in automated vehicle willingness and acceptance (Edelmann et al., 2021; Schoettle & Sivak, 2014; Syahrivar et al., 2021). For instance, Edelmann et al. (2021) found differences between samples from China, Japan, Germany and the US in terms of automated vehicle acceptance. Moreover, country differences were affected by situational factors. For example, while regardless of the case presented, drivers from China preferred automated vehicles, drivers' decisions from Japan were affected by the cases in which the automated system takes some decisions and affects other drivers (Edelmann et al., 2021). Similarly, Kaye et al. (2020) also found differences in acceptance and intention to use highly automated vehicles in Australia, France and Sweden. For instance, road users from France reported a higher intention to use highly automated vehicles than those from Australia and Sweden. In another study, Syahrivar et al. (2021) found that, compared to Hungarian participants, Indonesian participants had higher intention to use and more positive attitudes toward automated vehicles. Based on this, it is proposed that examining a proposed model across different countries might reveal some additional information.

One of the essential issues related to the studies about automated driving is that automated vehicles are currently not part of the regular traffic system, and little detail is provided about the automated vehicles (Buckley al., 2018). To overcome this problem, in the current study, participants were asked to choose their most preferred level of vehicle automation from the six levels. In the question, each level is defined with its capabilities (see Section 2.2.6.). Overall, considering the expected benefits and concerns associated with automated vehicles in terms of safety and the importance of road users' perception regarding the acceptance of the system, the current study focuses on the factors associated with the drivers' most preferred level of automation. With respect to this aim, the effects of traffic climate, traffic locus of control, and driving skills on the drivers' most preferred level of automation are examined. In the following sections, the significance of these variable for road safety and further importance for the present study is presented.

1.2. Traffic Climate

One of the important factors in terms of increasing road safety and decreasing undesirable outcomes such as road traffic accidents is the traffic climate (Chu et al., 2019). Özkan and Lajunen (2011) defined as “the road users’ (e.g., drivers’) attitudes and perceptions of the traffic in a context (e.g., country) at a given point in time”. Moreover, in another study, Gehlert et al. (2014) described traffic climate as a “function of a person being able to master a situation given its perceived properties and dynamic aspects as well as one’s own capabilities”. Considering these definitions, it was also suggested that the perception of safety climate could change based on the traffic environment and conditions (Chu et al., 2019). Moreover, as highlighted by Chu et al. (2019), traffic climate includes different practices, policies, procedures, routines, and sanctions. Drivers will experience effective interactions with other road users and the driving environment when the positive traffic climate achieved.

Based on the theoretical discussions (Özkan & Lajunen, 2011), Özkan and Lajunen (unpublished) developed the Traffic Climate Scale (TCS). Later, Gehlert et al. (2014), examined the factorial structure of the scale and found the three factors structure, namely external affective demands, internal requirements and functionality in Germany. The three factors structure was found to be reliable and valid in different countries such as Germany (Gehlert et al., 2014), China (Chu et al., 2019; Zhang et al., 2018), and Turkey (Üzümcüoğlu et al., 2019). External affective demands focus on emotional engagement while interactions with the traffic (e.g. annoying, chaotic and exciting). Internal requirements aim at individual skills and abilities as cognitive and social requirements to be able to successfully part of a traffic system (e.g. demands knowledge of traffic roles, demands compliance and demands caution). Finally, functional is related to the requirements of the functional traffic system (e.g. safe, planned and functional; Gehlert et al., 2014).

In terms of the relations between the traffic climate and various demographic variables such as age, sex and annual and total kilometres, Chu et al. (2019) observed only significant correlations between functionality and demographic variables. In other words, age, sex and driver licensing year were negatively correlated with functionality.

In another study, Zhang et al. (2018) found that age was positively correlated with functionality and negatively correlated with internal requirements. Moreover, being male is positively associated with external affective demands. In another study, age was negatively correlated with external affective demands and internal requirements and positively correlated with functionality (Qu et al., 2019). Üzümcüoğlu et al. (2019) found that total kilometres were positively correlated with external affective demands in Turkey. Moreover, while age was positively correlated with functionality in Turkey, the correlation was significantly negative in China. However, in another study, Üzümcüoğlu and Özkan (2019) did not find any significant relationships between age, gender, total kilometres and the dimensions of the traffic climate. Güner et al. (2018) also found that total kilometres were positively correlated with functionality and negatively correlated with external affective demands. Kaçan et al. (2019) conducted another study with participants from five different countries, namely Estonia, Greece, Kosovo, Russia, and Turkey. The correlations with age and annual kilometres showed that external affective demands were positively correlated with annual kilometres in Estonia and negatively correlated with age in Greece. Overall, it could be suggested that demographic variables show weak and contradictory relationships with dimensions of traffic climate. Based on this, it could also be proposed that road users evaluate traffic system similarly regardless of their demographic differences.

Different studies have examined the relations of the traffic climate with driver behaviours (Chu et al., 2019; Üzümcüoğlu et al., 2019; Zhang et al., 2018). Chu et al. (2019) investigated the relationships between traffic climate and dimensions of driver behaviours, as violations, errors, lapses and positive driver behaviours. Aberrant driver behaviours were measured with the Driver Behaviour Questionnaire (DBQ) that was developed based on two main components violations and errors. Errors were classified as slips, lapses, and mistakes and defined as “the failure of planned actions to achieve their intended consequences”. Violations that were differentiated as aggressive and ordinary violations were defined as “deliberate deviations from those practices believed necessary to maintain the safe operation of a potentially hazardous system” (Reason et al., 1990). Dimensions of aberrant driver behaviours, namely violations, errors and lapses, showed positive correlations with external affective demands and negative correlations with functionality. Moreover, internal requirements were only negatively related to errors. Contrary to these relations with the dimensions of aberrant driver behaviours, functionality and internal requirements were positively related to positive driver behaviours. After controlling for the effects of age, sex and lifetime kilometres, it was also found that external affective demands were positively related to violations, errors and lapses and negatively associated with positive driver behaviours. Besides, internal requirements were negatively related to violations and errors and positively related to positive driver behaviours. Finally, functionality was negatively related to violations and lapses and positively related to positive driver behaviours (Chu et al., 2019).

Üzümcüoğlu et al. (2019) also investigated the traffic climate and driver behaviours relationships in Turkey and China. Similar to the findings of Chu et al. (2019) in China, both in Turkey and China, external affective demands were positively related to violations and errors and negatively associated with positive driver behaviours. Moreover, internal requirements were positively associated with positive driver behaviours. However, only in Turkey, functionality was also negatively associated with violations and only in China, internal requirements were negatively associated with violations (Üzümcüoğlu et al., 2019). In another study, Zhang et al. (2018) had investigated the relations between the traffic climate and dimensions of Dula Dangerous Driving Index (DDDI; Dula & Ballard, 2003), namely total index score, negatively cognitive/emotional driving, aggressive driving, risky driving and drunk driving. It was found that internal requirements were negatively correlated with all forms of dangerous driving. Moreover, functionality was positively, and external affective demands were negatively related to drunk driving.

In addition to the studies with drivers, Xu et al. (2018a) investigated the role of traffic climate in pedestrian behaviours. It was found that age was positively correlated with functionality and negatively correlated with external affective demands. Moreover, external affective demands were positively correlated with three forms of aberrant pedestrian behaviours, transgression, aggressive violations and lapses. On the other hand, functionality was negatively correlated with transgression and lapses. Finally, internal requirements were positively correlated with positive pedestrian behaviours.

Similar to the results concerning drivers (Chu et al., 2019), when the traffic system was not perceived as functional, pedestrians were also engaged in aberrant behaviours (Xu et al., 2018a). Overall, studies had shown some differences in terms of the relationships of traffic climate with various driving outcomes; the general pattern suggests that the TCS is a reliable measurement for road safety.

When the relations between traffic climate and accidents were considered, different studies had found some contradictory relationships (Chu et al., 2019; Gehlert et al., 2014; Zhang et al., 2018). For instance, Chu et al. (2019) found that internal requirements had direct and external affective demands had indirect effects through violations and errors over accidents. Similar to Gehlert et al. (2014), Chu et al. (2019) highlighted that when the traffic system is high in emotional demands as external affective demands, drivers could increase the number of violations and experience more accidents. Moreover, internal requirements may result in an increased risk of accidents but also play a buffer role in aberrant driver behaviours (Chu et al., 2019). In addition to that, Zhang et al. (2018) found only significant correlations between the dimensions of traffic climate, penalty points and fines in the relations between functionality and fines. Functionality was negatively correlated with fines.

Overall, regarding a safe driving environment, Gehlert et al. (2014) proposed that a less emotionally and cognitively demanding (low in terms of external affective demands) and a more functional traffic system is perceived to be less risky and safer by the road users. Moreover, supporting this conclusion, Chu et al. (2019) also found that functionality and internal requirements were negatively related to aberrant driver behaviours and positively related to positive driver behaviours. Besides, external affective demands were positively associated with aberrant driver behaviours and negatively with positive driver behaviours. It was also highlighted that the properties of the traffic system in terms of driving skills and cognitive capabilities would help a safer driving environment. Moreover, Zhang et al. (2018) also stated that traffic systems that are high in terms of internal requirements resulted in fewer dangerous driver behaviours and more cautious driving. Contrary to previous findings (Chu et al., 2019; Gehlert et al., 2014; Üzümcüoğlu et al., 2019), Zhang et al. (2018) found negative relations between external affective demands and dangerous driving. It was stated that higher emotional demands coming from the traffic system might results in more careful driving due to the feeling of chaos and uncontrollability in the traffic system.

In addition to these, the traffic climate had been subjected to country comparisons in terms of road safety. For instance, Üzümcüoğlu et al. (2019) studied the effects of traffic climate on driver behaviours in Turkey and China. In terms of country differences, the traffic system in China was evaluated higher in terms of external affective demands and functionality than in Turkey. Contrary to these, drivers in Turkey evaluated the traffic system in Turkey as more internally demanding than drivers in China. Moreover, Chu et al. (2019) also linked traffic safety to two main components as the exposure to the situations and interactions with other road users. Both of these components were related to the functional and cognitive indicators. With the help of these components, road users could successfully evaluate the environment and behave in a way that results in positive outcomes.

Qu et al. (2019) study the relationships between traffic climate and autonomous vehicle acceptance. The results showed that external affective demands were positively related to concern scenarios and system concerns. Internal requirements were also positively correlated with all four dimensions of autonomous vehicle acceptance; benefits in usefulness, concern scenarios, benefits in situation and system concern. Finally, functionality was positively correlated with benefits in usefulness and system concern and negatively correlated with concern scenarios. Overall, Qu et al. (2019) found that traffic climate was a strong predictor of acceptance of autonomous vehicles. For example, when the traffic system is perceived to be emotionally demanding, drivers were more concerned about the problems that the system might cause. Moreover, drivers who perceived the traffic system as requiring more skills especially accepted autonomous vehicles when drivers were not recommended to the driver or even forbidden from driving. Finally, functionality was positively predicted benefits in usefulness and system concern indicating drivers who perceived traffic system as functional were both interested in usefulness and had concern about the autonomous system.

Considering the effects of traffic climate on various aspects of driving outcomes such as driver behaviours and accidents, it has been proposed that the perception of traffic climate of drivers will have an influence on the preferred level of vehicle automation. For example, if the current traffic system is perceived to be more emotionally demanding, drivers would prefer vehicles with higher automated systems. In other words, the traffic system with the perception it creates on the drivers can play a determining role in the level of automated vehicle drivers will prefer. With respect to this, in the present study, it is expected that different dimensions of traffic climate will be positively related to preferences toward higher levels of automation.

1.3. Traffic Locus of Control

One of the constructs associated with road safety is the locus of control/traffic locus of control. Rotter (1966) defined locus of control as a personality attribute indicating a person's tendency to perceive events to be under their or others' control. Perceiving events under a person's own control was labelled as an internal locus of control, whereas an external locus of control means that person perceives the events under the control of others or other outside forces. Based on this, Montag and Comrey (1987) differentiated driving specific locus of control and defined two dimensions; driving internality and driving externality. They found that while driving internality was positively associated with safe driving, driving externality was positively related to accident involvement. In another attempt to measure driving specific locus of control, Özkan and Lajunen (2005) introduced traffic locus of control and measured the construct with Multidimensional Traffic Locus of Control Scale (T-LoC). Traffic locus of control showed four dimensions as self (e.g. my own dangerous overtaking), vehicle and environment (e.g. a mechanical failure in the car), fate (e.g. bad luck) and other drivers (e.g. other drivers' risk-taking). In another study, Wallén Warner et al. (2010) examined the factorial structure of the traffic locus of control in Sweden and found five dimensions, namely other drivers, vehicle and environment, fate, own behaviour and own skills. Own behaviour and own skills dimensions were evaluated as the subdimensions of the self, which was found in the study of Özkan and Lajunen (2005). In addition to these, in the Romanian version of the T-LoC, Măirean et al. (2017) used six dimensions, namely, destiny-luck, religiosity, desirability, other drivers, internal locus of control and vehicle and environment. In a recent study conducted in China, Sun et al. (2020) also found four-factor structure as other drivers, self, vehicle/environment and fate.

In terms of the relations between the dimensions of traffic locus of control and demographic variables, Özkan and Lajunen (2005) found that age and licence year were not associated with traffic locus of control. On the other hand, lifetime kilometres were positively correlated with fate and being female is also positively related to vehicle and environment and other drivers. In another study, Huang and Ford (2012) did not find significant relations between age, gender and locus of control. On the other hand, in another study, age was negatively correlated with self, vehicle/environment and fate (Sun et al., 2020). Lemarié et al. (2019) also investigated the relationship between general locus of control and various driving-related characteristics and behaviours. They found that age and driving experience were significantly negatively correlated with the dimensions of external locus of control. Măirean et al. (2017) found that male drivers have a greater tendency to attribute to other drivers and vehicle and environment factors. In contrast, female drivers' attributions were more related to fate and luck. Holland et al. (2010) also found that female drivers had a higher external locus of control than male drivers. Similar to Holland et al. (2010), Sun et al. (2020) also found that female drivers attributed the causes of accidents to external factors as other drivers, vehicle/environment and fate more than male drivers.

In addition to the demographic differences, different studies have also examined the relationship between traffic locus of control and various driving outcomes such as driver behaviours, accidents and offences. For instance, Özkan and Lajunen (2005) found that drivers with a higher internal locus of control indicated by self-dimension of the multidimensional traffic locus of control also reported a higher number of accidents, offences, aggressive violations, ordinary violations and errors. Moreover, vehicle/environment was positively related to errors and negatively associated with offences. Finally, other drivers was negatively related to errors. The results indicated that young drivers who perceived the reasons for the traffic accidents as their own behaviours had been in more accidents than others who attribute road traffic accidents to other external factors (Özkan & Lajunen, 2005). In another study, driving externality was positively correlated with violations, lapses and errors. Moreover, the safest cluster of drivers was also high in terms of internal locus of control and low in external locus of control (Lucidi et al., 2010). Similar to the results of Lucidi et al. (2010) in which Montag and Comrey (1987)'s driving locus of control measurement used, Măirean et al. (2017) found that high-risk group of drivers consisted of drivers with medium or high external locus of control and low internal locus of control.

Sun et al. (2020) reported that other, vehicle/environment, and fate dimensions were negatively correlated with violations. Compared to drivers without traffic violations, drivers with traffic violations showed lower other, vehicle/environment, and fate factors. In terms of traffic accidents, drivers with traffic accidents also reported lower external factors and higher self than drivers without traffic accidents. It has also been found that dimensions of traffic locus of control had been associated with the driving style. For instance, drivers who had a higher tendency to attribute the causes of accidents to vehicle/environment and fate had more dissociate and anxious driving styles. Moreover, high self-attributing drivers, i.e. drivers who attribute the accidents to themselves, tend to have more dissociative, anxious, risky and angry driving styles. Those drivers also showed more traffic violations. In another study, internal locus of control was positively correlated with patient driving and negatively correlated with angry and risky driving styles, whereas external locus of control was positively correlated with dissociative and distress-reduction driving styles (Totkova, 2020).

Wallén Warner et al. (2010) investigated the effects of the traffic locus of control on the drivers' preferred speed on 50 km/h and 90 km/h after controlling for the effects of age, gender and licence year. For the 90 km/h speeding behaviours, vehicle and environment factor was positively and own (self) behaviour dimension was negatively related to time spent complying with the speed limits. In other words, drivers who believed that involving in an accident was under their own control were also speeding more. On the other hand, drivers believing the reasons for their accidents were mainly vehicles and environment had less speeding intention. Moreover, the dimensions of the traffic locus of control were not related to the 50 km/h speed limit. Hwang et al. (2018) also found that external and internal traffic locus of control had partial mediating roles in relations to the various psychological characteristics and reckless driving. For example, drivers who had a higher external locus of control were also more likely to speed. In another study, Alper and Özkan (2015) found that, after exposing mortality salience, external locus of control was negatively related to speeding. Young male drivers with a higher external locus of control, in other words, who believed the reasons for the accidents were mainly external and personally uncontrollable factors, showed less speeding violation.

Lemarié et al. (2019) found that external locus of control had potentially positive effects on road safety, whereas internal locus of control had negative effects. In other words, drivers who believe that general life events were controlled by powerful others behaved more cautiously than drivers who perceive the causes of accidents as their own. As discussed by Özkan and Lajunen (2005), due to the possible effects of over-confidence and optimistic bias, drivers with a higher internal locus of control may believe in their ability to avoid unsafe driving situations and this over-confidence and optimistic bias may increase accident involvement. Similarly, Wallén Warner et al. (2010) also found believing the reasons for the traffic accidents were drivers' own behaviour was also positively associated with speeding behaviours on 90 km/h roads. Considering these effects, Huang and Ford (2012) also highlighted that changing both internal and external driving locus of control is possible and may have important effects on driver behaviours. Even though studies had presented some contradictory findings, the results proposed that traffic locus of control is a reliable and valid measurement in the context of road safety in different countries such as Turkey (Özkan & Lajunen, 2005), Romania (Măirean et al., 2017) and Sweden (Wallén Warner et al., 2010).

Bıçaksız et al. (2019) also investigated the relationships between traffic locus of control and accepted level of automation. The results indicated an overall low level of acceptance in terms of automation, and only, fate dimension was also positively related to the accepted level of automation. Drivers with higher attribution of the accidents to fate had found higher levels of automation as more acceptable. In another study, Syahrivar et al. (2021) found a positive association between external locus of control and attitudes toward automated vehicles. In other word, drivers with a higher external locus of control had more favourable attitudes toward automated vehicles.

As discussed earlier, automated vehicles promise a lot for traffic safety. Considering the existence of different perspectives in terms of the effects of automated vehicles on traffic accidents, it is thought that how drivers perceive or attribute the causes of traffic accidents will be effective in the preference of automated vehicles. On the other hand, differences in automated driving levels give drivers a choice that may affect specific situations in traffic. Sharing the control of the vehicle with a system other than the driver or leaving it completely to the system adds a separate factor for all situations in case of an accident, injury or near misses. In this case, the reasons for which drivers attribute the accidents may result in interpreting traffic situations in different ways. This may also affect the attitudes towards different automation levels, causing drivers to show different preferences toward these levels. For example, drivers who attribute traffic accidents to errors of vehicles are expected to prefer lower levels of automated vehicles. On the contrary, drivers who attribute the causes of accidents to themselves are expected to prefer higher levels of automated vehicles.

1.4. Driving Skills

Human factors were evaluated as the most important factor concerning road traffic accidents (Lewin, 1982; Treat et al., 1977). Parker and Stradling (2001) differentiated driver-related human factors as driver behaviours and driving skills. While driver behaviours focus on what drivers actually do while driving as individual driving styles, driving skills are associated with information-processing and motor skills by investigating what drivers can do while driving (Elander et al., 1993; Lajunen & Özkan, 2011). Lajunen and Summala (1995) differentiated driving skills as perceptual-motor skills (e.g. controlling the vehicle and performance in a critical situation) and safety skills (e.g. driving carefully and staying calm in irritating situations) and measured with the Driving Skills Inventory (DSI). A similar factor structure had been found in Finland (Lajunen & Summala, 1995), Australia (Lajunen et al., 1998), Germany (Ostapczuk et al., 2017), Greece, Sweden (Wallén Warner et al., 2013), China (Xu et al., 2018b) and Turkey (Sümer et al., 2006). Similarly, Özkan et al. (2006) also suggested that the DSI could be used to compare the driving skills of drivers from different countries. In addition to these, differences in terms of driving skills had been observed between countries. For example, Wallén Warner et al. (2013) found that drivers from Greece, Turkey and Sweden had higher perceptual-motor skills than drivers from Finland. On the other hand, drivers from Greece, Turkey, and Finland had higher safety skills than drivers from Sweden.

Various studies had been examined the relations between demographic variables and driving skills. In one study, Özkan and Lajunen (2006) found that age was positively associated with perceptual-motor skills. Moreover, Ostapczuk et al. (2017) also found that age was positively associated with both safety skills and perceptual-motor skills. Contrary to these, Öztürk and Özkan (2018) and Xu et al. (2018b) did not find significant correlations between age and driving skills. Özkan and Lajunen (2006) found that female drivers have higher levels of safety skills and lower levels of perceptual-motor skills. In another study, Ostapczuk et al. (2017) found that female drivers had higher safety skills than male drivers in two studies, whereas the difference for perceptual-motor skills was not significant in one study, and males reported higher perceptual-motor skills in other study. Xu et al. (2018b) also found that being male is significantly associated with perceptual-motor skills.

In addition to age and gender differences, Ostapczuk et al. (2017) also found that licence year and lifetime kilometres were also positively correlated with perceptual-motor skills. Similarly, Öztürk and Özkan (2018) also found that last year kilometres were positively correlated with perceptual-motor skills and negatively correlated with safety skills. Moreover, Xu et al. (2018b) also found that annual and total kilometres and licence year were positively associated with perceptual-motor skills.

Regarding the effects of driving skills on driver behaviours, Ostapczuk et al. (2017) also found that perceptual-motor skills were positively, and safety skills were negatively correlated with average speed within the city, between cities and highway roads. Moreover, Öztürk and Özkan (2018) also found that perceptual-motor skills were positively related to aberrant driver behaviours and positive driver behaviours. Moreover, safety skills were negatively related to violations and speeding behaviours in a driving simulator but positively related to positive driver behaviours. Similarly, Xu et al. (2018b) also found that safety skills were negatively correlated with aberrant driver behaviours and positively correlated with positive driver behaviours.

In terms of accidents and offences, Özkan and Lajunen (2006) found that drivers with higher levels of perceptual-motor skills had more accidents and offences than drivers with higher safety skills. Moreover, in another study, safety skills were also negatively related to accident involvement in different countries such as Greece and Turkey. Even though considerable effects of safety skills on yearly accident involvement had been found at the individual level, country-level accidents statistics could not be explained by self-reported safety skills (Wallén Warner et al., 2013). Moreover, Ostapczuk et al. (2017) also found that the number of penalties were positively associated with perceptual-motor skills and negatively associated with safety skills, whereas no relationship was found between driving skills and the number of accidents. Similarly, Xu et al. (2018b) also found negative correlations between penalty points, fines and safety skills.

Considering the relations of perceptual-motor skills and safety skills with various driving outcomes mentioned above, Sümer et al. (2006) suggested an asymmetric relationship of perceptual-motor skills and safety skills with unsafe driving outcomes such as penalties. In other words, perceptual-motor skills were positively, and safety skills were negatively associated with penalties. Even though the asymmetric relationship had been found with unsafe driving outcomes, Xu et al. (2018b) and Öztürk and Özkan (2018) found the symmetric relationship between driving skills and positive driver behaviours, indicating that skilful drivers who had higher perceptual-motor skills and safety skills showed more positive driver behaviours.

However, Martinussen et al. (2017) also discussed that a young male driver was inconsistent with their self-reported driving skills. Drivers with fewer skills or drivers who were more experienced were more inconsistent in terms of their skill measurement. Similarly, de Craen et al. (2011) also indicated small correlations between risk perception, objectively assessed safe driving abilities and driving skills. Novice drivers were evaluated to be more optimistic when asked to compare themselves with peer drivers. Overall, de Craen et al. (2011) also highlighted that even though novice drivers had a tendency to overestimate their driving skills compared to the assessment of experts, they were aware of their limitations and not optimistic about their driving skills.

All in all, driving skills are one of the crucial dimensions of human factors in driving and had been related to various outcomes in driving. Concerning its importance, it has been expected that how drivers perceive their driving skills will have an important role in vehicle preference. It was expected that safety skills and perceptual-motor skills would have different effects on the preference for automated vehicles. In details, drivers with higher perceptual-motor skills are expected to prefer vehicles with lower levels of automation, whereas drivers with higher safety skills are expected to choose higher levels of automated vehicles.

1.5. Road Safety in Turkey and Sweden

WHO (2018) showed that there are regional and country-based differences in terms of road traffic accident and fatalities. For instance, Sweden and Turkey have certain differences in terms of road safety. According to the World Health Organization (2018), the estimated fatality rate per 100 000 population for Sweden is 2.8, whereas for Turkey is 12.3. The enforcement scores are also different between Sweden and Turkey. Sweden is also one of the high-performing countries of safety system approach with respect to road safety (WHO, 2018). According to the road safety performance index report of the European Transport Safety Council (ETSC, 2020), in 2019, Sweden decreased the number of road traffic deaths by 32% from the previous year, and Sweden is one of the three safest countries for road users together with Norway and Switzerland. Moreover, previous research conducted with Swedish and Turkish drivers also showed many behavioural, attitudinal and skill differences. In the study of Wallén Warner et al. (2009), Swedish drivers reported more positive attitudes towards complying with the speed limit, subjective norm and also higher perceived behavioural control than Turkish drivers. Moreover, Swedish drivers also reported complying with the speed limit more than Turkish drivers. In another study, Turkish drivers reported more aggressive violations, ordinary violations, disregarding speed limit than Swedish drivers (Wallén Warner et al., 2011).

In the study of Wallén Warner et al. (2013), Turkish drivers reported higher safety skills than Swedish drivers, whereas the difference in perceptual-motor skills was not significant. Unlike Sweden, safety skills were also negatively related to accident involvement in Turkey. However, even though the relationship between safety skills and the number of fatalities in Sweden and Turkey seems to be contradicted on a country level, individual level of safety skills had negative relations with accident involvement. Drivers with a higher level of safety skills involved fewer accidents (Wallén Warner et al., 2013). With respect to the statistics and behavioural differences, it can be suggested that investigating the psychological mechanisms behind road safety-related factors between Sweden and Turkey will provide valuable information for the future of road safety research.

1.6. The Aim of the Present Thesis

When autonomous vehicles with different levels are included in the traffic environment, they may cause significant changes in the structure of the traffic system. On the contrary, in the current traffic system, drivers may perceive the traffic system differently and arrange their behaviours and needs based on their perceptions of the traffic system. For instance, Üzümcüoğlu et al. (2020a) discussed that the traffic climate of a country plays an essential role in relations to driver behaviours. That relationship was also changed as a function of driving skills. Considering that, it is expected that there might be a two-way relationship between the future of automated driving and traffic climate. Based on this, it is anticipated that the dimensions of traffic climate will have significant positive associations with drivers' automated vehicle choices. It is hypothesised that if the current traffic system is perceived to be high in terms of emotional demands or internal requirements, drivers may prefer higher levels of vehicle automation to fulfil the demands and requirements coming from the traffic system. Contrary to this, drivers who perceive the traffic system as high in terms of functionality may not show significant preferences toward certain levels of automation.

Considering the differences in terms of drivers' perception of the causes of accidents (Özkan & Lajunen, 2005), potential paradigm shifts in the traffic system and accident causation due to automated vehicles (Noy et al., 2018) and relations between locus of control and automated driving (Bıçaksız et al., 2019), it is proposed that traffic locus of control will have a significant role in regards to drivers' automated vehicle preferences. Drivers who attribute road traffic accidents to internal factors will have a positive tendency to prefer higher levels of automation. Since those drivers think the accidents occurred due to their own skills and behaviours, they may want to give more control to the automated system. On the other hand, drivers who attribute traffic accidents to external factors (i.e. errors of vehicles and other drivers) are expected to prefer lower levels of automated vehicles. For instance, if drivers perceive that accidents occur due to technical errors of vehicles or behaviours of other drivers, they may want to have more control over their vehicle and, as a result, the driving environment and prefer vehicles with lower levels of automation. It was expected that fate would not be related to drivers' automated vehicle preferences.

In addition to that, automated vehicles present different technologies associated with driving. From this point of view, it could be discussed that these technologies may have an impact on driving skills. With the new vehicle technologies, the current understanding of driving skills may change. In other words, new skills may be needed, and some skills may become dysfunctional and disappear. Similarly, it can also be proposed that drivers' current understanding of driving skills may also have a relationship with the vehicles they drive. For instance, drivers who value safety skills might prefer to drive vehicles with higher safety functions. In other words, drivers' own skill evaluation might have an impact on the vehicle preference. Drivers may evaluate their own skills and the technical capabilities of vehicles and choose the best option accordingly. Drivers might be evaluating their driving skills based on what they can do with the available vehicle technology, so new technologies or different levels of automated vehicles can be a compensatory factor if they see themselves lacking certain skills. For instance, if a driver is having problems with reserve parking, this driver may also prefer a vehicle with that technology. Based on this, it is proposed that driving skills may have an effect on drivers' automation preferences. More specifically, it is expected that drivers with higher perceptual-motor skills will have a tendency to prefer lower levels of automated vehicles. Contrary to perceptual-motor skills, drivers with higher safety skills will prefer higher levels of automation.

In addition to these direct relations of traffic climate, traffic locus of control and driving skills with the automation preference of drivers, it is also proposed that there will be more complex and dynamic associations between these variables. As discussed by Özkan and Lajunen (2011), traffic climate might affect the behaviours of the road users in a hierarchical structure as a broader umbrella concept. More specifically, as visualised in Figure 1, in the final model, the moderating role of traffic climate in relations between traffic locus of control/driving skills and automated vehicle preference of drivers by country will be tested. In details, it was hypothesised that traffic climate would have a moderator role on the relationship between traffic locus of control/driving skills and automated vehicle preference. Higher external affective demands and internal requirements will have a booster role resulting in a higher preference toward automated vehicles with internal locus of control and safety skills. It was also expected that, based on the differences in road safety statistics, the moderator effects will differ in Turkey and Sweden. For instance, it is expected that, in Turkey, external affective demands will have a positive effect on the expected negative relationship between perceptual-motor skills and drivers' automated vehicle preference. In other words, when drivers with higher perceptual-motor skills perceive the traffic system as low in terms of external affective demands, they will prefer lower levels of automated vehicles in Turkey.

Following these aims and the importance of and expectations from automated vehicles, the aims of the present thesis are to investigate the gender and country difference in the preferred level of vehicle automation and the effects of traffic climate, traffic locus of control and driving skills on the drivers' most preferred level of automated vehicles. Considering that different factors associated with traffic climate, driver characteristics (Üzümcüoğlu Zihni, 2018) and automated vehicle acceptance (Edelmann et al., 2021) showed cross-country difference; the relations were examined in Turkey and Sweden. To do so, first, participants from Turkey and Sweden were compared based on demographic variables. Secondly, the factorial structure of the measurements for each country and congruity between Turkey and Sweden were tested. After that, item and factor-based country comparisons and gender differences in terms of study variables were examined. Following gender and country differences, six hierarchical regression analyses were conducted in order to test the roles of traffic climate, driving skills and traffic locus of control separately for Turkey and Sweden. Finally, in the final model, the effects of driving skills and traffic locus of control on the preferred level of vehicle automation by traffic climate on the two countries (Turkey and Sweden) while controlling for the effects of age, gender and last year kilometres were examined (see Figure 1.).

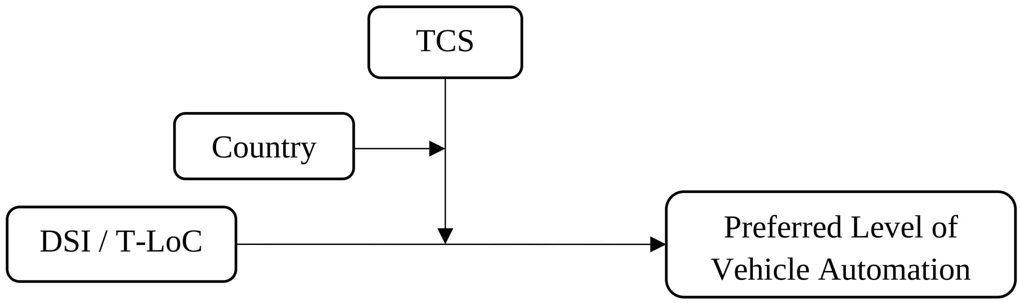

Figure 1. *The Proposed Model of the Present Thesis*

CHAPTER 2

METHOD

2.1. Participants

2.1.1. Turkey

A total of 318 drivers between the ages of 18 and 38 years (*M* = 22.41, *SD* = 2.77) participated in the study. A hundred and five participants were males, and 213 participants were females. All participants were university students and had a valid full B-driving license (years with license *M* = 3.03 years, *SD* = 2.47). Last year, the participants had, on average, driven 5374.37 kilometres (*SD* = 11938.40). Furthermore, they had been involved in, on average, 0.59 (*SD* = 1.24) active (situations in which drivers hit any object and/or other road users) and 0.25 (*SD* = 0.58) passive (situations in which other road users hit drivers) accidents in the last three years.

2.1.2. Sweden

A total of 312 drivers between the ages of 20 and 55 participated in the study (*M* = 28.80, *SD* = 8.53). A hundred and twenty-four of the participants were males, 186 participants were females, and two participants reported other gender identity. All participants were university students and had a valid full B-driving licence (years with license *M* = 9.03 years, *SD* = 8.10). Last year the participants had, on average, driven 9133.21 kilometres (*SD* = 16635.13). Furthermore, they had, on average, been involved in 0.21 (*SD* = 0.49) active (situations in which drivers hit any object and/or other road users), and 0.14 (*SD* = 0.40) passive (situations in which other road users hit drivers) accidents in the last three years was.

2.1.3. Comparison between the Samples from Turkey and Sweden

With respect to the demographic variables mentioned above, independent samples t-test analyses were conducted to test the differences between Turkey and Sweden (see Table 1.). The results showed that the sample from Sweden was significantly older, had a higher license year, last year kilometres, and lower passive accidents and active accidents than the sample from Turkey. Considering these differences and correlations between the factors, age and last year kilometres were used as control variables for country comparisons in future analyses.

Table 1. ***Cross-Country Differences among Study Variables***

	Turkey		Sweden		*df*	*t*	*p*
	M	*SD*	*M*	*SD*			
Age	22.41	2.77	28.80	8.53	374.71	-12.61	.000
Li.Year	3.03	2.47	9.03	8.10	366.17	-12.50	.000
LY_Km	5374.37	11938.41	9133.21	16635.13	444.33	-3.00	.003
AA	0.59	1.24	0.21	0.49	413.43	5.11	.000
PA	0.25	0.58	0.14	0.40	564.98	2.80	.005

Note. Li.Year: License year, LY_KM: Last year kilometres, AA: Active accidents, PA: Passive accidents

2.2. Materials

The web-based questionnaire was constructed in English (the common language between the researcher and his advisors) and then translated into Turkish and Swedish, respectively. If previously translated, back-translated and validated instruments were available, the existing versions were used. Otherwise, the questionnaire was back-translated to English within the frame of this project. The questionnaire included demographic information, the traffic climate scale, the multidimensional traffic locus of control scale, the driving skills inventory, as well as questions about automation preference. It also included the basic personality trait inventory and demographic questions regarding automation levels they heard of and their experiences related to these levels, but the results will not be presented here.

2.2.1. Demographic Information

The form included demographic questions such as age and gender and driving-related questions such as last year kilometre and the number of accidents.

2.2.2. Traffic Climate Scale

The scale was developed by Özkan and Lajunen (unpublished) in Turkish to measure the perception of road users for the characteristics of a country's traffic system on three dimensions, as external affective demands, internal requirements, and functionality. The scale includes 44 items in 6-point Likert-type from 1 (does not describe it at all) to 6 (describes it fully). Following the suggestions by Üzümcüoğlu et al. (2020b) regarding the factorial structure of the TCS across five countries, all analyses, including the factorial structure of the TCS was examined with the 16 items-short version. Factorial structures and Cronbach's alpha reliabilities of the subscales could be found in section 3.1.1.1. for Turkey and 3.1.2.1. for Sweden.

2.2.3. Multidimensional Traffic Locus of Control Scale

The scale was developed by Özkan and Lajunen (2005) to measure the degree to which a person attributes to causes of the accident into self, other drivers, vehicle/environment and fate. In the current study, the Turkish version (Özkan & Lajunen, 2005) and the Swedish version (Wallén Warner et al., 2010) were used. Participants were asked to rate items based on how possible the items would cause an accident considering their own driver style and conditions. The scale is rated in 5-point Likert from 1 (not at all possible) to 5 (highly possible) and consists of 17 items. Factorial structures and Cronbach's alpha reliabilities of the subscales could be found in section 3.1.1.2. for Turkey and 3.1.2.2. for Sweden.

2.2.4. Driving Skills Inventory

The scale was developed by Lajunen and Summala (1995) for the measurement of driving abilities of drivers based on two dimensions, perceptual-motor skills and safety skills. The Turkish (Lajunen & Özkan, 2004) and Swedish (Wallén Warner et al., 2013) adaptations of the scale were reliable and valid. The scale consists of 20 items with 5-point Likert-type from 1 (very weak) to 5 (very strong). Factorial structures and Cronbach’s alpha reliabilities of the subscales could be found in section 3.1.1.3. for Turkey and 3.1.2.3. for Sweden.

2.2.5. Preferred Level of Vehicle Automation

As the dependent variable question, participants were asked to answer a single question related to their most preferred automation level. The question is formed as “Below the description of different levels of automation are given. As a driver, which of these levels do you prefer?”. After that, brief definitions of each level (from 0 to 5) were given.

“Below the description of different levels of automation are given. As a driver, which of these levels do you prefer?

□ No-Automation (level 0): The driver performs all tasks during the entire drive. For example, a reversing camera warning for collisions provide warnings but the driver needs to take all the action.

□ Driver Assistance (level 1): The systems perform sub-driving tasks such as steering or acceleration/deceleration under certain conditions. For example, lane centring systems which help the driver to stay in the right lane or adaptive cruise control which ensures that the driver maintains a safe distance to the vehicle in front. The driver is expected to perform all other driving tasks as well as continuously monitor the systems and intervene if needed.

□ Partial Automation (level 2): The systems perform sub-driving tasks, such as steering and acceleration/deceleration under certain conditions. For example, lane centring systems which help the driver to stay in the right lane and adaptive cruise control which ensures that the driver maintains a safe distance to the vehicle in front at the same time. The driver is expected to perform all other driving tasks as well as continuously monitor the systems and intervene if needed.

□ Conditional Automation (level 3): The systems perform all dynamic driving tasks such as overtaking under limited conditions. For example, traffic jam chauffeur that drives the vehicle in ques. The driver is expected to continuously monitor the systems and intervene if needed.

 High Automation (level 4): The systems perform all dynamic driving tasks such as overtaking under limited conditions. For example, local driverless taxis that drive the vehicle within a restricted area. The driver is not obliged to intervene.

 Full Automation (level 5): The systems perform all dynamic driving tasks under all conditions. The driver only enters the destination in the system and is not obliged to intervene."

2.3. Procedure

Before the data collection began, ethical permission was obtained from the Middle East Technical University Human Research Ethics Committee. The Swedish and Turkish versions of the questionnaire were distributed using Qualtrics, an online survey platform. Convenience and snowball sample methods were used to reach university students. Participants were expected to meet two prerequisites (i.e. having a valid type B driving license and being a university student). The data was collected during spring/summer of 2020 (from March 2020 to July 2020). In Turkey, university students were recruited through social media challenges, lecturers from other universities and the Department of Psychology METU Research Sign-Up System. In Sweden, university students' e-mail addresses were obtained from LADOK (a student registration and grading document system used by all Swedish colleges and universities. The system also includes personal information such as the students' e-mail addresses). University students were then recruited by e-mail, including a link to the web-based questionnaire. When the students followed the link, they found the web-based questionnaire on the online survey platform Qualtrics, beginning with the informed consent form.

2.4. Analyses

After completing the data collection process, data were analysed by using SPSS v26. First of all, samples from Turkey and Sweden were compared based on demographic variables. Secondly, principal component analyses with Promax rotation were conducted to test the factorial structures of the measurements across samples from Turkey and Sweden. Based on the factorial structures, the equivalence of factorial solutions of three scales was examined by comparing the rotated factor matrices using Procrustes target rotation technique and factorial agreement coefficients in which data from Turkey was used as a target group. Following the suggestions of van de Vijver and Leugn (1997) and ten Berge (1986), values over .95 meant factorial similarity between Turkey and Sweden, whereas below .90 (van de Vijver & Leugn, 1997) or .85 (ten Berge, 1986) indicated factorial nonnegligible incongruities. After finalising the factorial structure of the subscales and calculating mean values based on loaded items, descriptive statistics and bivariate correlation coefficients between the variables were presented. Following that, item-based cross-country comparisons and factor-based gender and country comparisons were tested. Other gender identity group was excluded from further analyses for gender difference due to limited sample size (N = 2) in Sweden and in Turkey (N = 0).

In order to examine separate effects of traffic climate, traffic locus of control and driving skills, three different regression analyses were conducted after controlling the effects of age, last year kilometres and gender for each country. Finally, based on the proposed model of the study (see Figure 1.) and the moderated moderation analysis defined by Hayes (2018), the moderation effects of the traffic climate on the relationship between traffic locus of control/driving skills and drivers' automation preferences while moderated by the country (Turkey and Sweden) were performed for the factors achieving factorial similarity across Turkey and Sweden. The analyses were performed by using PROCESS macro for SPSS with 5000 samples bootstrapping. As discussed by Morris et al. (1986), statistical power could be lower while testing interaction effects. In light of this, p-value to determine the statistical significance was determined as .10. For probing significant interaction effects, pick-a-point approach was administered. The conditioning values were determined as mean and one standard deviation above and below the mean.

CHAPTER 3

RESULTS

3.1. Factorial Structure of the Measurements across Turkey and Sweden

In order to examine the factorial structure of the three measurements (TCS, T-LoC, and DSI), six principal component analyses (PCA) were conducted.

3.1.1. Factor Analyses for the Sample from Turkey

3.1.1.1. Factor Analysis on Traffic Climate Scale

A factor analysis on the 16 items of the Traffic Climate Scale was conducted by using principal component analysis. For the rotation, Promax with Kaiser Normalization was used. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was found as .91, and Bartlett's Test of Sphericity was found to be significant (df = 120, p < .001), showing that the correlation matrix from the items of the scale is factorable. Three factors had eigenvalues over 1.0. Following the theoretical framework of TCS (Gehlert et al., 2014; Özkan & Lajunen, unpublished; Üzümcüoğlu et al., 2020b) and the scree plot, three factors solution was decided as the best factor structure (Table 2.).

The first factor explained 40.43% of the variance. The initial eigenvalue of the factor was 6.47. The majority of the items were related to the skills and abilities that are required in the traffic system, so the factor was named internal requirements (IR). The final version of the dimension included six items. The communalities of these items were between .75 and .55.

The second factor explained 13.92% of the variance. The initial eigenvalue of the factor was 2.23. The items were associated with the functionality of the traffic system, so the factor was also named functionality (FUN). The final version of the dimension included five items. The communalities of these items were between .72 and .50.

The final factor explained 6.75% of the variance. The initial eigenvalue of the factor was 1.08. The items were related to the emotional engagement with the traffic system, so the factor was named as external affective demands (EAD). The final version of the dimension included five items. The communalities of these items were between .67 and .35.

Table 2. ***Factor Loadings and the Communality Values of the Items of the Traffic Climate Scale with Promax Rotation in Turkey***

	Factors			Communality
	IR	FUN	EAD	
Demands alertness	**.93**			.75
Requires vigilance	**.92**			.67
Demands cautiousness	**.90**			.71
Aggressive	**.76**			.61
Stressful	**.68**			.55
Chaotic	**.54**			.58
Functional		**.84**		.72
Free flowing		**.82**		.60
Harmonious		**.76**	.43	.50
Safe		**.74**		.67
Planned		**.72**		.57
Time consuming			**.75**	.60
Depends on one's luck		.31	**.70**	.35
Pressurizing			**.67**	.58
Annoying	.33		**.49**	.67
Makes one irritated	.41		**.44**	.66

Note. IR: Internal Requirements, FUN: Functionality, EAD: External Affective Demands, Factor loadings < .30 are suppressed.

The factor loadings of the items for corresponding factors and their communality values are shown in Table 2. Total variance explained by three factors was found as 61.08%. Only one item "makes one irritated" was highly cross-loaded into two factors but retained on the factor with highest loadings considering the theoretical background (Özkan & Lajunen, unpublished; Üzümcüoğlu et al., 2020b). The Cronbach's alpha reliabilities of the scales were found as .75 for external affective demands, .81 for functionality and .88 for internal requirements.

3.1.1.2. Factor Analysis on Traffic Locus of Control Scale

A factor analysis on the 17 items of the Traffic Locus of Control Scale was conducted by using principal component analysis. For the rotation, Promax with Kaiser Normalization was used. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was found as .81, and Bartlett's Test of Sphericity was found to be significant (df = 136, $p < .001$), showing that the correlation matrix from the items of the scale is factorable. Five factors had eigenvalues over 1.0. Based on the theoretical framework of T-LoC, previous studies (Özkan & Lajunen, 2005; Wallén Warner et al., 2010) and the scree plot, five factors solution was decided as the best factor structure (Table 3.).

The first factor consisted of six items and explained 29.67% of the variance with the initial eigenvalue of 5.04. The majority of the items were about the vehicle and environment conditions, so the dimension is named vehicle and environment (VE). The communalities of these items were between .71 and .47.

The second factor consisted of four items and explained 12.54% of the variance with the initial eigenvalue of 2.13. The items were about drivers own skills, so the dimension is named as own skills (OS). The communalities of these items were between .77 and .49.

The third factor consisted of three items and explained 10.04% of the variance with the initial eigenvalue of 1.71. The items were about bad luck and fate factors, so the dimension is named fate. The communalities of these items were between .70 and .65.

The fourth factor consisted of two items and explained 7.45% of the variance with the initial eigenvalue of 1.27. The items were about other drivers' behaviours and skills, so the dimension is named as other drivers (OD). The communalities of these items were between .70 and .68.

The final factor consisted of two items and explained 5.98% of the variance with the initial eigenvalue of 1.02. The items were about drivers' own and others close following behaviours. Following the highest loaded item and other fifth factor in the second country, the factor named as own behaviours (OB). The communalities of these items were between .79 and .64.

The factor loadings of the items for corresponding factors and their communality values are shown in Table 3. Total variance explained by five factors was found as 65.68%. The Cronbach's alpha reliabilities of the scales were found as .84 for vehicle and environment, .76 for own skills, .75 for fate, .64 for other drivers' behaviours and skills and .49 for own behaviours.

Table 3. ***Factor Loadings and the Communality Values of the Items of the Traffic Locus of Control Scale with Promax Rotation in Turkey***

	Factors					Communality
	VE	OS	F	OD	OB	
Bad weather or lighting conditions	**.92**					.70
Other drivers driving under influence of alcohol	**.83**					.71
A mechanical failure in the car	**.76**					.55
Dangerous roads	**.71**					.47
Other drivers' dangerous overtaking	**.65**					.69
Other drivers often drive with too high speed	**.57**					.60
My own risk-taking while driving		**.90**				.77
I often drive with too high speed		**.71**				.72
Shortcomings in my driving skills		**.63**		.37		.49
My own dangerous overtaking	.32	**.51**				.64
Coincidence			**.83**			.70
Fate			**.81**			.66
Bad luck			**.78**			.65
Shortcomings in other drivers' driving skills				**.84**		.68
Other drivers' risk-taking while driving				**.74**		.70
I drive too close to the car in front					**.95**	.79
Other drivers drive too close to my car					**.62**	.64

Note. VE: Vehicle and Environment, OS: Own Skills, F: Fate, OD: Other Drivers, OB: Own Behaviours, Factor loadings < .30 are suppressed.

3.1.1.3. Factor Analysis on Driving Skills Inventory

A factor analysis on the 20 items of the Driving Skills Inventory was conducted using principal component analysis. For the rotation, Promax with Kaiser Normalization was used. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was found as .88, and Bartlett's Test of Sphericity was found to be significant (df = 190, p < .001), showing that the correlation matrix from the items of the scale is factorable. Three factors had eigenvalues over 1.0. Following the theoretical framework of DSI (Lajunen & Summala, 1995) and the scree plot, two factors solution was decided as the best factor structure (Table 4.).

The first factor consisted of 12 items and explained 28.26% of the variance. The items were about technical skills and abilities, so the factor named perceptual-motor skills. The communalities of these items were between .64 and .27. The initial eigenvalue of the factor was 5.65.

The second factor consisted of 7 items and explained 17.46% of the variance. The items were related to safety skills, so the factor named safety skills. The communalities of these items were between .69 and .21. The initial eigenvalue of the factor was 3.49.

Table 4. ***Factor Loadings and the Communality Values of the Items of the Driving Skills Inventory with Promax Rotation in Turkey***

	Factors		Communality
	PMS	SS	
Fluent driving	**.78**		.64
Controlling the vehicle	**.74**		.59
Knowing how to act in particular traffic situations	**.72**		.53
Reverse parking into a narrow gap	**.70**		.50
Perceiving hazards in traffic	**.70**		.50
Making firm decisions	**.70**		.49
Overtaking	**.68**		.48
Predicting traffic situations ahead	**.66**		.44
Make a hill start on a steep incline	**.64**		.44
Managing the car through a skid	**.55**		.32
Fluent lane-changing in heavy traffic	**.50**		.35
Tolerating other drivers' errors calmly	**.49**		.27

Table 4. ***continued.***

	Factors		Communality
	PMS	SS	
Avoiding unnecessary risks		**.82**	.69
Conforming to the speed limits		**.74**	.62
Keeping a sufficient following distance		**.67**	.46
Obeying the traffic lights carefully		**.66**	.45
"Relinquishing" legitimate rights when necessary		**.62**	.44
Driving behind a slow car without getting impatient		**.56**	.34
Adjusting your speed to the conditions	.43	.46	.40
Staying calm in irritating situations		**.45**	.21

Note. PMS: Perceptual-Motor Skills, SS: Safety Skills, Factor loadings < .30 are suppressed.

One item (Adjusting your speed to the conditions) was removed from the scale because of being equally and highly loaded into the two factors and showing factorial inconsistency in different studies (Lajunen & Summala, 1995; Öztürk, 2017; Wallén Warner et al., 2013). Total variance explained by two factors was found as 45.72%. The factor loadings of the items for corresponding factors and their communality values are shown in Table 4. The Cronbach's alpha reliabilities of the scales were found .88 for perceptual-motor skills and .77 for safety skills.

3.1.2. Factor Analyses for the Sample from Sweden

3.1.2.1. Factor Analysis on Traffic Climate Scale

A factor analysis on the 16 items of the Traffic Climate Scale was conducted by using principal component analysis. For the rotation, Promax with Kaiser Normalization was used. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was found as .82, and Bartlett's Test of Sphericity was found to be significant (df = 120, p < .001), showing that the correlation matrix from the items of the scale is factorable. Four factors had eigenvalues over 1.0. Following the theoretical framework of TCS (Gehlert et al., 2014; Özkan & Lajunen, unpublished; Üzümcüoğlu et al., 2020b) and the scree plot, three factors solution was decided as the best factor structure (Table 5.).

The first factor explained 26.55% of the variance. The initial eigenvalue of the factor was 4.25. The items were related to the emotional engagement with the traffic system, so the factor was named as external affective demands (EAD). The final version of the dimension included eight items. The communalities of these items were between .62 and .19.

The second factor explained 16.23% of the variance. The initial eigenvalue of the factor was 2.60. The items were associated with the functionality of the traffic system, so the factor was also named functionality (FUN). The final version of the dimension included five items. The communalities of these items were between .67 and .49.

The final factor explained 9.74% of the variance. The initial eigenvalue of the factor was 1.56. The items were related to the skills and abilities that are required in the traffic system, so the factor was named internal requirements (IR). The final version of the dimension included three items. The communalities of these items were between .66 and .54.

Table 5. ***Factor Loadings and the Communality Values of the Items of the Traffic Climate Scale with Promax Rotation in Sweden***

	Factors			Communality
	EAD	FUN	IR	
Annoying	**.78**			.62
Chaotic	**.69**			.56
Makes one irritated	**.69**			.51
Stressful	**.65**			.52
Time consuming	**.63**			.34
Pressurizing	**.62**			.53
Aggressive	**.52**			.45
Depends on one's luck	**.48**			.19
Planned		**.79**		.60
Functional		**.79**		.67
Safe		**.72**		.51
Harmonious		**.71**		.49
Free flowing		**.71**		.61
Demands alertness			**.81**	.62
Demands cautiousness			**.82**	.66
Requires vigilance			**.73**	.54

Note. EAD: External Affective Demands, FUN: Functionality, IR: Internal Requirements, Factor loadings < .30 are suppressed.

The factor loadings of the items for corresponding factors and their communality values are shown in Table 5. Total variance explained by three factors was found as 52.52%. The Cronbach's alpha reliabilities of the scales were .79 for external affective demands, .80 for functionality and .74 for internal requirements.

3.1.2.2. Factor Analysis on Traffic Locus of Control Scale

A factor analysis on the 17 items of the Traffic Locus of Control Scale was conducted by using principal component analysis. For the rotation, Promax with Kaiser Normalization was used. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was found as .81, and Bartlett's Test of Sphericity was found to be significant (*df* = 136, $p < .001$), showing that the correlation matrix from the items of the scale is factorable. Five factors had eigenvalues over 1.0. Based on the theoretical framework of T-LoC, previous studies (Özkan & Lajunen, 2005, Wallén Warner et al., 2010) and the scree plot, five factors solution was decided as the best factor structure (Table 6.).

The first factor consisted of four items and explained 27.50% of the variance with the initial eigenvalue of 4.68. The items were about other drivers' behaviours and skills, so the dimension is named other drivers (OD). The communalities of these items were between .68 and .58.

The second factor consisted of four items and explained 12.78% of the variance with the initial eigenvalue of 2.17. The items were about the vehicle and environment conditions, so the dimension is named vehicle and environment (VE). The communalities of these items were between .71 and .56.

The third factor consisted of four items and explained 9.59% of the variance with the initial eigenvalue of 1.63. The items were about bad luck and fate factors, so the dimension is named fate. The communalities of these items were between .72 and .51.

The fourth factor consisted of three items and explained 7.45% of the variance with the initial eigenvalue of 1.27. The items were about drivers' own behaviours while driving, so the factor named as own behaviours (OB). The communalities of these items were between .71 and .56.

The final factor consisted of two items and explained 5.97% of the variance with the initial eigenvalue of 1.02. The items were about drivers own skills, so the dimension is named as own skills (OS). The communalities of these items were between .77 and .727.

The factor loadings of the items for corresponding factors and their communality values are shown in Table 6. Total variance explained by five factors was found as 63.29%. The Cronbach's alpha reliabilities of the scales were found as .80 for other drivers' behaviours and skills, .74 for vehicle and environment, .68 for fate, .61 for own behaviours and .71 for own skills.

Table 6. ***Factor Loadings and the Communality Values of the Items of the Traffic Locus of Control Scale with Promax Rotation in Sweden***

	Factors					Communality
	OD	VE	F	OB	OS	
Other drivers' risk-taking while driving	**.79**					.68
Shortcomings in other drivers' driving skills	**.79**					.66
Other drivers often drive with too high speed	**.76**					.61
Other drivers drive too close to my car	**.74**					.58
Other drivers driving under influence of alcohol		**.75**				.67
A mechanical failure in the car		**.74**				.57
Bad weather or lighting conditions		**.62**				.56
Other drivers' dangerous overtaking	.47	**.56**				.71
Bad luck			**.83**			.72
Fate			**.70**		-.33	.55
Coincidence			**.69**			.62
Dangerous roads			**.43**			.51
I often drive with too high speed				**.85**		.71
I drive too close to the car in front				**.73**		.57
My own dangerous overtaking		.42		**.52**		.56
Shortcomings in my driving skills					**.86**	.77
My own risk-taking while driving				.37	**.70**	.73

Note. OD: Other Drivers, VE: Vehicle and Environment, F: Fate, OB: Own Behaviours, OS: Own Skills, Factor loadings < .30 are suppressed.

3.1.2.3. Factor Analysis on Driving Skills Inventory

A factor analysis on the 20 items of the Driving Skills Inventory was conducted using principal component analysis. For the rotation, Promax with Kaiser Normalization was used. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was found as .805, and Bartlett's Test of Sphericity was found to be significant (df = 190, p < .001), showing that the correlation matrix from the items of the scale is factorable. Five factors had eigenvalues over 1.0. According to the theoretical framework of DSI (Lajunen & Summala, 1995) and the scree plot, two factors solution was decided as the best factor structure (Table 7.).

The first factor consisted of 11 items and explained 22.24% of the variance. The items were about technical skills and abilities, so the factor named perceptual-motor skills. The communalities of these items were between .50 and .17. The initial eigenvalue of the factor was 4.45.

The second factor consisted of eight items and explained 16.02% of the variance. The items were related to safety skills, so the factor named safety skills. The communalities of these items were between .59 and .21. The initial eigenvalue of the factor was 3.20.

Table 7. ***Factor Loadings and the Communality Values of the Items of the Driving Skills Inventory with Promax Rotation in Sweden***

	Factors		Communality
	PMS	SS	
Knowing how to act in particular traffic situations	**.71**		.50
Making firm decisions	**.67**		.45
Fluent lane-changing in heavy traffic	**.67**		.46
Overtaking	**.64**		.44
Predicting traffic situations ahead	**.63**		.40
Make a hill start on a steep incline	**.61**		.38
Fluent driving	**.61**		.36
Reverse parking into a narrow gap	**.59**		.38
Controlling the vehicle	**.58**		.34
Perceiving hazards in traffic	**.55**		.31
Managing the car through a skid	**.37**		.17
Conforming to the speed limits		**.73**	.59

Table 7. ***continued.***

	Factors		Communality
	PMS	SS	
Driving behind a slow car without getting impatient		**.68**	.57
Adjusting your speed to the conditions		**.68**	.47
Staying calm in irritating situations		**.67**	.45
Avoiding unnecessary risks		**.64**	.41
Keeping a sufficient following distance		**.64**	.40
Tolerating other drivers' errors calmly		**.57**	.34
Obeying the traffic lights carefully		**.38**	.21
"Relinquishing" legitimate rights when necessary			.02

Note. PMS: Perceptual-Motor Skills, SS: Safety Skills, Factor loadings < .30 are suppressed.

One item ("Relinquishing" legitimate rights when necessary) was removed from the scale because of not loading into any of the factors over .30 cut-off. Total variance explained by two factors was found as 38.26%. The factor loadings of the items for corresponding factors and their communality values are shown in Table 7. The Cronbach's alpha reliabilities of the scales were found as .82 for perceptual-motor skills and .78 for safety skills.

3.1.3. Target Rotation and Agreement Coefficients

The Procrustes target rotation techniques and factorial agreement coefficients were used to calculate the rotated factor matrices. Table 8 shows the index values. Based on the coefficient of proportionality which is the most widely accepted index and also known as Tucker's phi, the factorial similarity between the samples from Turkey and Sweden were achieved for external affective demands, functionality, internal requirements, vehicle and environment, own skills, fate, other drivers, perceptual-motor skills and safety skills (over .84). Functionality, internal requirements and fate dimensions (over .95) and perceptual-motor skills (.94) showed full identity between the two countries. Own behaviours dimension of traffic locus of control showed sign of nonnegligible incongruity (Table 8.).

Table 8. ***Four Identity Indexes of TCS, T-LoC and DSI***

	Identity coefficient	Additivity coefficient	Proportionality coefficient	Correlation coefficient
EAD	.83	.75	.84	.76
FUN	.97	.96	.97	.96
IR	.91	.87	.95	.91
VE	.87	.79	.90	.83
OS	.91	.89	.91	.89
F	.95	.94	.95	.94
OD	.88	.86	.90	.88
OB	.69	.65	.69	.65
PMS	.94	.85	.94	.86
SS	.87	.80	.87	.80

Note. EAD: External Affective Demands, FUN: Functionality, IR: Internal Requirements, VE: Vehicle and Environment, OS: Own Skills, F: Fate, OD: Other Drivers, OB: Own Behaviours, PMS: Perceptual-Motor Skills, SS: Safety Skills.

3.2. Descriptive Statistics and Correlations

3.2.1. Descriptive Statistics and Correlations in Turkey

In terms of the automated vehicle, the preferences of the drivers were as follows: 51 drivers (16%) for level 0, 61 drivers (19.2%) for level 1, 96 drivers (30.2%) for level 2, 45 drivers (14.2%) for level 3, 20 drivers (6.3%) for level 4 and 45 drivers (14.2%) for level 5. The means, standard deviations and correlation coefficients for age, license year, last year kilometres, active accident in the last three years, passive accident in the last three years, automation preference, external affective demand, functionality, internal requirements, vehicle and environment, own skills, fate, other drivers, own behaviours, perceptual-motor skills, safety skills were given in Table 9.

The correlation coefficients in Turkey revealed some crucial significant correlations. For example, age was positively correlated with vehicle and environment, own skills and safety skills. Automation preference was positively correlated with safety skills and negatively correlated with last year kilometres and perceptual-motor skills. External affective demands were negatively correlated with functionality and positively correlated with internal requirements, safety skills and all factors of traffic locus of control. While safety skills were positively correlated with external affective demands, vehicle and environment and internal requirements, perceptual-motor skills were positively correlated with functionality. Internal requirements were positively correlated with vehicle and environment, other drivers, own behaviours and safety skills. Vehicle and environment was positively correlated with all other factors of traffic locus of control and safety skills.

Table 9. ***Correlation Coefficients in Turkey***

	Age	LiYe	LYKm	AA	PA	AP	EAD	FUN	IR	VE	OS	F	OD	OB	PMS	SS
Age	1															
LiYe	.82**	1														
LYKm	.08	.16**	1													
AA	-.03	-.01	.26**	1												
PA	-.02	.08	.22**	.28**	1											
AP	.03	-.03	-.12*	-.08	-.04	1										
EAD	.04	.02	.01	-.08	-.04	.06	1									
FUN	-.11	-.12*	.03	.04	-.01	.04	-.40**	1								
IR	.10	.07	-.06	-.02	-.02	.05	.68**	-.36**	1							
VE	.12*	.06	-.10	-.20**	-.13*	-.02	.22**	-.03	.25**	1						
OS	.16**	.09	-.00	-.02	-.12*	.02	.11*	-.00	.05	.42**	1					
F	-.08	-.11	.13*	-.08	-.08	.07	.12*	.20**	-.03	.13*	.04	1				
OD	.07	.08	.05	-.08	.08	.04	.24**	-.05	.32**	.42**	.30**	.18**	1			
OB	.09	.08	.02	-.13*	-.07	.00	.15**	-.02	.13*	.39**	.34**	.04	.28**	1		
PMS	.01	.14*	.27**	.06	.26**	-.21**	-.11	.12*	-.07	-.06	-.12*	-.02	.04	-.08	1	
SS	.11*	.02	-.12*	-.21**	-.18**	.13*	.13*	.00	.21**	.14*	-.05	-.03	.10	.02	-.03	1
M	22.41	3.03	5374.37	0.59	0.25	3.18	4.48	3.12	5.20	4.00	3.15	2.44	4.09	3.32	3.41	3.95
SD	2.77	2.47	11938.40	1.24	0.58	1.57	0.88	0.91	0.76	0.76	1.06	0.93	0.73	0.96	0.64	0.60

Note. *. Correlation is significant at the 0.05 level. **. Correlation is significant at the 0.01 level. LiYe: License year, LYKm: Last year kilometres, AA: Active accidents in the last three years, PA: Passive accidents in the last three years, AP: Automation preference, EAD: External affective demands, FUN: Functionality, IR: Internal requirements, VE: Vehicle and environment, OS: Own skills, F: Fate, OD: Other drivers, OB: Own behaviours, PMS: Perceptual-motor skills, SS: Safety skills.

3.2.2. Descriptive Statistics and Correlations in Sweden

In terms of the automated vehicle, the preferences of the drivers were as follows: 85 drivers (27.2%) for level 0, 68 drivers (21.8%) for level 1, 71 drivers for level 2 (22.8%), 40 drivers (12.8%) for level 3, 13 drivers (4.2%) for level 4 and 35 drivers (11.2%) for level 5. The means, standard deviations and correlation coefficients for age, license year, last year kilometres, active accident in the last three years, passive accident in the last three years, automation preference, external affective demand, functionality, internal requirements, vehicle and environment, own skills, fate, other drivers, own behaviours, perceptual-motor skills, safety skills were given in Table 10.

Some crucial correlations were determined in Sweden. For example, age was positively correlated with perceptual-motor skills and negatively correlated with functionality. Automation preference was positively correlated with own skills. External affective demands were positively correlated with internal requirements and negatively correlated with functionality. Vehicle and environment was positively correlated with all other factors of traffic locus of control and safety skills. Safety skills were positively correlated with functionality, internal requirements, vehicle and environment and other drivers and negatively correlated with external affective demands and own behaviours.

Table 10. ***Correlation Coefficients in Sweden***

	Age	LiYe	LYKm	AA	PA	AP	EAD	FUN	IR	VE	OS	F	OD	OB	PMS	SS
Age	1															
LiYe	.94**	1														
LYKm	.14*	.12	1													
AA	-.05	-.06	.01	1												
PA	-.05	-.04	.11	.11*	1											
AP	.06	.07	.08	.01	.02	1										
EAD	.04	.07	.01	.03	.01	-.08	1									
FUN	-.16**	-.18**	-.05	-.04	-.07	.01	-.34**	1								
IR	.06	.06	.03	-.05	.02	-.05	.20**	.09	1							
VE	.10	.10	.08	.03	-.05	-.05	.09	.01	.30**	1						
OS	.03	-.00	.12	.07	-.00	.11*	-.09	.06	.10	.23**	1					
F	.01	.00	-.02	.01	-.05	-.02	.15**	-.07	.17**	.46**	.09	1				
OD	.06	.07	.12	-.02	-.05	-.08	.12*	-.02	.26**	.54**	.22**	.33**	1			
OB	-.04	-.04	-.06	.16**	.02	.01	-.08	.04	-.12*	.14*	.40**	.09	.09	1		
PMS	.12*	.17**	.10	-.06	.05	-.11	-.05	.06	-.01	.01	-.09	.04	.12*	.10	1	
SS	-.00	-.02	.01	-.14*	-.09	-.04	-.15**	.16**	.24**	.18**	.01	.06	.18**	-.50**	-.12*	1
M	28.80	9.03	9133.21	0.21	0.14	2.79	2.94	4.00	4.29	3.60	2.64	2.92	3.94	3.94	3.56	3.70
SD	8.53	8.10	16635.13	0.49	0.40	1.60	0.73	0.77	0.91	0.82	1.01	0.88	0.75	0.75	0.53	0.62

Note. *. Correlation is significant at the 0.05 level. **. Correlation is significant at the 0.01 level. LiY: License year, LYKM: Last year kilometres, AA: Active accidents in the last three years, PA: Passive accidents in the last three years, AP: Automation preference, EAD: External affective demands, FUN: Functionality, IR: Internal requirements, VE: Vehicle and environment, OS: Own skills, F: Fate, OD: Other drivers, OB: Own behaviours, PMS: Perceptual-motor skills, SS: Safety skills.

3.3. Item-Based Cross-Country Comparisons

3.3.1. Item-Based Cross-Country Comparisons – the TCS

A total of sixteen ANCOVAs, including age, gender, and last year kilometres as control variables, were conducted to test the country differences among the Traffic Climate Scale items. After controlling for the statistical effects of age, gender and last year kilometres, all comparisons showed significant country differences (see Table 11.). The largest differences were observed for "chaotic", "aggressive", "stressful" and "annoying". Contrary, the smallest differences were found for "harmonious", "free-flowing", "time consuming" and "demands alertness".

Table 11. ***Factor-based Country Level Comparisons – the TCS***

	Turkey (N = 303)		Sweden (N = 251)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
Chaotic	4.72	1.18	2.30	1.16	1, 549	530.19	.000	.49*
Aggressive	5.16	1.07	3.04	1.24		373.69	.000	.41*
Stressful	5.26	.91	3.37	1.20		336.46	.000	.38*
Annoying	4.87	1.17	2.90	1.04		331.92	.000	.38*
Makes one irritated	4.94	1.06	3.20	1.21		242.73	.000	.31*
Safe	2.85	1.21	4.30	.97		213.10	.000	.28*
Pressurizing	4.56	1.28	2.91	1.14		204.16	.000	.27*
Demands cautiousness	5.44	.78	4.19	1.11		192.22	.000	.26*
Planned	2.83	1.18	4.20	1.06		187.99	.000	.26*
Requires vigilance	5.28	.93	4.18	1.04		147.18	.000	.21*
Functional	3.23	1.14	4.25	1.01		145.86	.000	.21*
Depends on one's luck	3.59	1.33	2.08	1.15		138.49	.000	.20*
Demands alertness	5.28	.90	4.70	1.09		36.59	.000	.06*
Time consuming	4.39	1.31	3.65	1.15		34.09	.000	.06*
Free flowing	3.42	1.20	3.88	1.04		29.91	.000	.05*
Harmonious	3.27	1.28	3.46	1.11		6.69	.010	.01*

Note. Variables were listed based on F-values (from highest to lowest). * significant difference.

3.3.2. Item-Based Cross-Country Comparisons – the T-LoC

In order to test the country differences among items of the Traffic Locus of Control, several ANCOVAs were conducted, including age, gender and last year kilometres as control variables. After controlling for the statistical effects, twelve significant differences were found (see Table 12.). The largest differences were found for "My own dangerous overtaking", "Coincidence", and "A mechanical failure in the car". The difference was not significant for "Fate", "My own risk-taking while driving", "Other drivers drive too close to my car", "Other drivers' risk-taking while driving" and "Bad weather or lighting conditions".

Table 12. ***Factor-based Country Comparisons – the T-LoC***

	Turkey (N = 303)		Sweden (N = 251)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
My own dangerous overtaking	3.64	1.40	2.21	1.05		136.74	.000	.20*
Coincidence	2.32	1.02	3.06	1.15		46.20	.000	.08*
A mechanical failure in the car	3.63	1.20	2.95	1.18		36.41	.000	.06*
Bad luck	2.65	1.13	3.22	1.27		34.20	.000	.06*
Other drivers driving under influence of alcohol	4.39	1.00	3.89	1.12		30.79	.000	.05*
Other drivers often drive with too high speed	4.25	.89	3.89	.97		21.57	.000	.04*
I drive too close to the car in front	2.82	1.28	2.27	1.04	1, 549	19.93	.000	.04*
I often drive with too high speed	3.23	1.48	2.69	1.21		16.36	.000	.03*
Other drivers' dangerous overtaking	4.36	.90	4.04	1.06		14.81	.000	.03*
Dangerous roads	3.63	1.05	3.33	1.19		7.13	.008	.01*
Shortcomings in other drivers' driving skills	3.85	.90	4.06	.95		4.97	.026	.01*
Shortcomings in my driving skills	2.90	1.23	2.69	1.17		4.32	.038	.01*
Fate	2.34	1.27	2.08	1.33		3.66	.056	.01

Table 12. ***continued.***

	Turkey (*N* = 303)		Sweden (*N* = 251)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
My own risk-taking while driving	2.82	1.42	2.71	1.13	1, 549	3.10	.079	.01
Other drivers drive too close to my car	3.77	1.05	3.72	1.03		1.70	.193	.00
Other drivers' risk-taking while driving	4.31	.81	4.24	0.88		1.56	.213	.00
Bad weather or lighting conditions	3.72	1.06	3.67	1.00		0.85	.357	.00

Note. Variables were listed based on F-values (from highest to lowest). * significant difference.

3.3.3. Item-Based Cross-Country Comparisons – the DSI

In order to test the country difference among items of the Driving Skills Inventory, several ANCOVAs were conducted, including age, gender and last year kilometres as control variables. After controlling for the statistical effects of age, gender and last year kilometres, twelve significant differences were found (see Table 13.). The highest differences were found for "Fluent lane-changing in heavy traffic", "'Relinquishing' legitimate rights when necessary". The smallest differences were seen for "Make a hill start on a steep incline" and "Adjusting your speed to the conditions".

Table 13. ***Factor-based Country Comparisons – the DSI***

	Turkey (*N* = 303)		Sweden (*N* = 251)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
Fluent lane-changing in heavy traffic	2.53	1.06	3.41	.92	1, 549	76.09	.000	.12*
"Relinquishing" legitimate rights when necessary	4.22	.77	3.58	.85		66.17	.000	.11*
Fluent driving	3.46	.94	3.98	.74		44.31	.000	.08*
Conforming to the speed limits	3.94	.96	3.25	1.15		43.70	.000	.07*

Table 13. *continued.*

	Turkey (N = 303)		Sweden (N = 251)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
Reverse parking into a narrow gap	3.28	1.33	2.89	1.37		19.35	.000	.03*
Driving behind a slow car without getting impatient	3.48	1.15	3.07	1.26		13.70	.000	.02*
Avoiding unnecessary risks	4.13	.83	3.85	.78		12.67	.000	.02*
Keeping a sufficient following distance	4.09	.68	3.84	.91		8.80	.003	.02*
Managing the car through a skid	3.00	.91	2.91	.99		7.92	.005	.01*
Predicting traffic situations ahead	3.40	1.00	3.69	.75		4.03	.045	.01*
Staying calm in irritating situations	3.27	1.17	3.56	1.03		4.03	.045	.01*
Obeying the traffic lights carefully	4.52	.65	4.57	.66	1, 549	3.89	.049	.01*
Making firm decisions	3.61	.90	3.79	.73		2.46	.118	.00
Perceiving hazards in traffic	3.68	.80	3.67	.72		2.37	.124	.00
Overtaking	3.66	.91	3.76	.83		2.00	.158	.00
Controlling the vehicle	3.93	.74	4.00	.61		1.24	.267	.00
Tolerating other drivers' errors calmly	3.30	.88	3.22	.93		1.22	.270	.00
Knowing how to act in particular traffic situations	3.63	.93	3.68	.77		.35	.555	.00
Adjusting your speed to the conditions	4.08	.72	4.04	.84		.02	.891	.00
Make a hill start on a steep incline	3.86	1.04	3.90	1.04		.01	.910	.00

Note. Variables were listed based on F-values (from highest to lowest). * significant difference.

3.4. Gender Differences within Countries

A series of analyses of covariance in which age and last year kilometres were control variables were conducted to examine the differences between male and female drivers in Turkey and Sweden separately.

3.4.1. Gender Differences in Turkey

In order to test the gender differences among study variables in Turkey, several ANCOVAs were conducted, including age and last year kilometres as control variables (see Table 14.). After controlling for the statistical effects of age and last year kilometres, significant gender differences were found for automation preferences, internal requirements, vehicle and environment and perceptual-motor skills. The differences were not significant for other drivers, functionality, own behaviours, safety skills, own skills, external affective demands and fate. The highest difference was found for perceptual-motor skills. Male drivers reported higher perceptual-motor skills and preferred higher levels of automation than female drivers. Moreover, female drivers reported higher internal requirements and vehicle and environment than male drivers in Turkey.

Table 14. ***Gender Differences among Variables in Turkey***

	Male (N = 103)		Female (N = 200)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
PMS	3.70	.59	3.31	.60		26.50	.000	.08*
AP	3.47	1.77	2.97	1.42		7.80	.006	.03*
VE	3.84	.75	4.08	.76		7.44	.007	.02*
IR	5.08	.76	5.24	.75		3.85	.051	.01*
OD	4.00	.71	4.12	.75		2.67	.104	.01
FUN	3.02	.96	3.18	.88	1, 299	1.61	.205	.01
OB	3.23	.96	3.32	.93		1.06	.304	.00
SS	3.91	.63	3.97	.54		.81	.369	.00
OS	3.12	1.05	3.16	1.06		.51	.478	.00
EAD	4.34	.90	4.49	.89		.33	.565	.00
F	2.39	.93	2.46	.94		.31	.581	.00

Note. AP: Automation Preference, EAD: External Affective Demands, FUN: Functionality, IR: Internal Requirements, VE: Vehicle and Environment, OS: Own Skills, F: Fate, OD: Other Drivers, OB: Own Behaviours, PMS: Perceptual-Motor Skills, SS: Safety Skills. Variables were listed based on F-values (from highest to lowest). * significant difference.

3.4.2. Gender Differences in Sweden

To examine the gender differences among variables within Sweden, several ANCOVAs were conducted, including age and last year kilometres as control variables (see Table 15.). After controlling for the statistical effects of age and last year kilometres, significant gender differences were found for automation preferences, internal requirements, vehicle and environment, fate, other drivers, perceptual-motor skills and safety skills. The highest difference was found for other drivers, whereas the differences were not significant for functionality, own skills, own behaviours and external affective demands. Male drivers preferred higher levels of automation and reported more perceptual-motor skills than female drivers. On the other hand, female drivers reported higher internal requirements, vehicle and environment, fate, other drivers and safety skills than male drivers in Sweden.

Table 15. ***Gender Differences among Variables in Sweden***

	Male (N = 110)		Female (N = 141)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
OD	3.76	.79	4.14	.71		19.48	.000	.07*
VE	3.42	.84	3.81	.81		15.64	.000	.06*
IR	4.13	.86	4.52	.80		14.88	.000	.06*
F	2.69	.82	3.11	.91		13.90	.000	.05*
PMS	3.75	.52	3.50	.52		13.37	.000	.05*
SS	3.56	.61	3.77	.55	1, 247	8.32	.004	.03*
AP	3.07	1.70	2.62	1.44		4.93	.027	.02*
EAD	2.84	.78	3.00	.70		3.05	.082	.01
OB	2.44	.80	2.35	.86		.92	.338	.00
OS	2.73	1.04	2.67	.98		.05	.826	.00
FUN	4.02	.82	4.02	.73		.01	.923	.00

Note. AP: Automation Preference, EAD: External Affective Demands, FUN: Functionality, IR: Internal Requirements, VE: Vehicle and Environment, OS: Own Skills, F: Fate, OD: Other Drivers, OB: Own Behaviours, PMS: Perceptual-Motor Skills, SS: Safety Skills. Variables were listed based on F-values (from highest to lowest). * significant difference.

3.5. Gender by Country Comparisons

In order to examine the gender and country difference among variables in the total sample, a series of two-way between-subjects factorial ANCOVAs in which gender (1: Male, 2: Female) and Country (1: Turkey, 2: Sweden) as independent variables and age and last year kilometres as control variables was conducted. In the following sections, respectively, the main effects of gender, the main effects of country and the interaction effects were presented.

3.5.1. Gender Differences

After controlling for the statistical effects of age and last year kilometres, significant main effects of gender were found for automation preference, internal requirements, vehicle and environment, fate, other drivers, perceptual-motor skills and safety skills (see Table 16.). The highest difference was observed for perceptual-motor skills, whereas the differences were not significant for own behaviours, own skills, functionality and external affective demands. Overall, in the total sample, male drivers reported a higher preference toward higher levels of automation and perceptual-motor skills than female drivers. Besides, female drivers revealed higher internal requirements, vehicle and environment, fate, other drivers and safety skills than male drivers.

Table 16. ***Gender Differences among Variables in the Total Sample***

	Male (N = 213)		Female (N = 341)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
PMS	3.73	.55	3.39	.57	1, 548	35.69	.000	.06*
VE	3.62	.82	3.97	.79		20.63	.000	.04*
OD	3.87	.76	4.13	.73		18.02	.000	.03*
IR	4.59	.94	4.95	.85		16.10	.000	.03*
AP	3.26	1.74	2.82	1.44		12.90	.000	.02*
F	2.55	.89	2.73	.98		10.30	.001	.02*
SS	3.73	.64	3.89	.56		6.09	.014	.01*
EAD	3.61	1.14	3.88	1.10		2.33	.128	.00

Table 16. ***continued.***

	Male (*N* = 213)		Female (*N* = 341)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
FUN	3.53	1.02	3.52	.92		1.20	.274	.00
OS	2.92	1.06	2.96	1.06	1, 548	.00	.954	.00
OB	2.82	.97	2.92	1.02		.00	.972	.00

Note. AP: Automation Preference, EAD: External Affective Demands, FUN: Functionality, IR: Internal Requirements, VE: Vehicle and Environment, OS: Own Skills, F: Fate, OD: Other Drivers, OB: Own Behaviours, PMS: Perceptual-Motor Skills, SS: Safety Skills. Variables were listed based on F-values (from highest to lowest). * significant difference.

3.5.2. Cross-Country Differences

After controlling for the statistical effects of age and last year kilometres, significant country differences were found for automation preference, external affective demands, functionality, internal requirements, vehicle and environment, own skills, fate, other drivers, own behaviours and safety skills (see Table 17.). The highest difference was observed for the three dimensions of traffic climate, whereas the difference was not significant for perceptual-motor skills. Drivers in Turkey reported higher external affective demands, internal requirements, vehicle and environment, own skills, other drivers, own behaviours and safety skills than drivers in Sweden. Drivers in Turkey also preferred higher levels of automation than drivers in Sweden. Besides, compared to drivers in Turkey, drivers in Sweden revealed higher functionality and fate scores.

Table 17. ***Factor-based Country Comparisons***

	Turkey (*N* = 303)		Sweden (*N* = 251)		*df*	*F*	*p*	η_p^2
	M	*SD*	*M*	*SD*				
EAD	4.47	.88	2.93	.74		374.70	.000	.41*
FUN	3.12	.91	4.02	.77		161.78	.000	.23*
IR	5.19	.76	4.35	.85	1, 548	123.97	.000	.18*
OB	3.29	.94	2.39	.83		92.64	.000	.15*
VE	4.00	.76	3.64	.84		28.50	.000	.05*

Table 17. *continued.*

	Turkey (N = 303)		Sweden (N = 251)		df	F	p	η_p^2
	M	SD	M	SD				
F	2.44	.94	2.92	.90	1, 548	27.96	.000	.05*
OS	3.14	1.06	2.70	1.01		25.16	.000	.04*
SS	3.95	.57	3.68	.59		23.72	.000	.16*
AP	3.14	1.57	2.82	1.57		9.00	.003	.02*
OD	4.08	.74	3.97	.77		5.00	.026	.01*
PMS	3.45	.62	3.61	.53		2.14	.144	.00

Note. AP: Automation Preference, EAD: External Affective Demands, FUN: Functionality, IR: Internal Requirements, VE: Vehicle and Environment, OS: Own Skills, F: Fate, OD: Other Drivers, OB: Own Behaviours, PMS: Perceptual-Motor Skills, SS: Safety Skills. Variables were listed based on F-values (from highest to lowest). * significant difference.

*3.5.3. Gender * Country Interactions*

Significant interaction effects were found for fate and other drivers (see Table 18.). For male ($F(1, 548) = 5.11$, $p = .024$, $\eta_p^2 = .01$) and female ($F(1, 548) = 36.27$, $p < .001$, $\eta_p^2 = .06$) drivers' fate scores, drivers in Sweden reported stronger fate than their fellows in Turkey. While female drivers had a stronger fate than male drivers in Sweden ($F(1, 548) = 14.58$, $p < .001$, $\eta_p^2 = .03$), the difference was not significant in Turkey ($F(1, 548) = .42$, $p = .519$, $\eta_p^2 = .00$, see Figure 2.).

For other drivers, female drivers in Sweden had higher other drivers scores than male drivers in Sweden ($F(1, 548) = 19.07$, $p < .001$, $\eta_p^2 = .03$). The difference for drivers in Turkey was not significant ($F(1, 548) = 2.48$, $p = .116$, $\eta_p^2 = .00$). On the other hand, the only significant difference was found for male drivers in other drivers ($F(1, 548) = 8.07$, $p = .005$, $\eta_p^2 = .02$). Male drivers in Turkey had stronger other drivers than male drivers in Sweden. The difference between female drivers was not significant ($F(1, 548) = .11$, $p = .742$, $\eta_p^2 = .00$, see Figure 3.).

Table 18. ***Gender * Country Interactions***

	Turkey		Sweden					
	Male *M (SD)*	Female *M (SD)*	Male *M (SD)*	Female *M (SD)*	*df*	*F*	*p*	η_p^2
F	2.39 (.93)	2.46 (.94)	2.69 (.82)	3.11 (.91)	1, 548	5.45	.020	.01*
OD	4.00 (.71)	4.12 (.75)	3.76 (.79)	4.14 (.71)		4.38	.037	.01*
IR	5.08 (.77)	5.24 (.75)	4.13 (.86)	4.53 (.80)		2.68	.102	.01
PMS	3.70 (.59)	3.32 (.60)	3.75 (.52)	3.50 (.52)		2.39	.123	.00
SS	3.91 (.63)	3.97 (.54)	3.56 (.61)	3.77 (.55)		2.03	.155	.00
OB	3.23 (.96)	3.32 (.93)	2.44 (.80)	2.35 (.86)		1.39	.239	.00
VE	3.84 (.75)	4.08 (.76)	3.42 (.84)	3.81 (.81)		1.12	.290	.00
FUN	3.02 (.96)	3.18 (.88)	4.02 (.82)	4.02 (.73)		.72	.396	.00
EAD	4.44 (.86)	4.49 (.89)	2.84 (.78)	3.01 (.70)		.50	.480	.00
OS	3.12 (1.05)	3.16 (1.06)	2.73 (1.04)	2.67 (.98)		.35	.552	.00
AP	3.47 (1.77)	2.97 (1.42)	3.07 (1.70)	2.62 (1.44)		.00	.981	.00

Note. AP: Automation Preference, EAD: External Affective Demands, FUN: Functionality, IR: Internal Requirements, VE: Vehicle and Environment, OS: Own Skills, F: Fate, OD: Other Drivers, OB: Own Behaviours, PMS: Perceptual-Motor Skills, SS: Safety Skills. Variables were listed based on F-values (from highest to lowest). * significant difference.

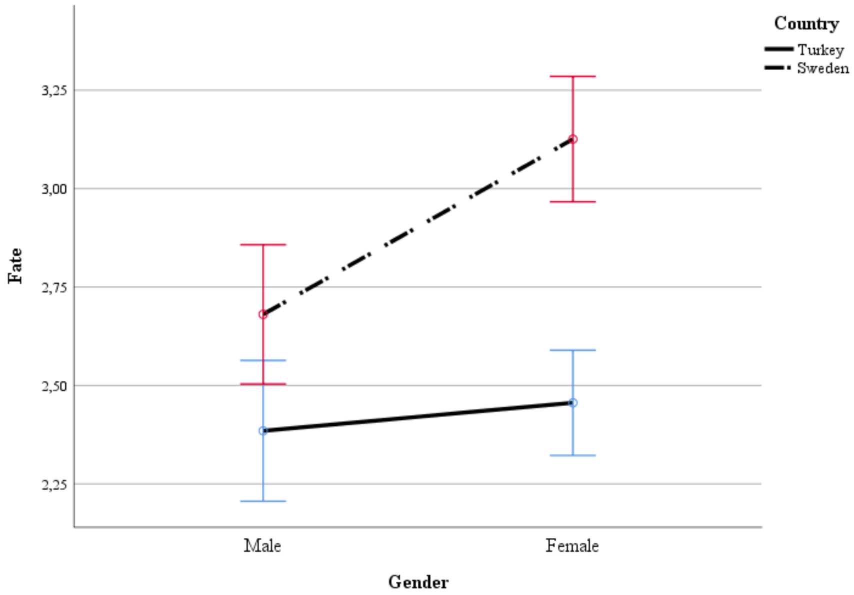

Figure 2. *Gender by Country – Fate*

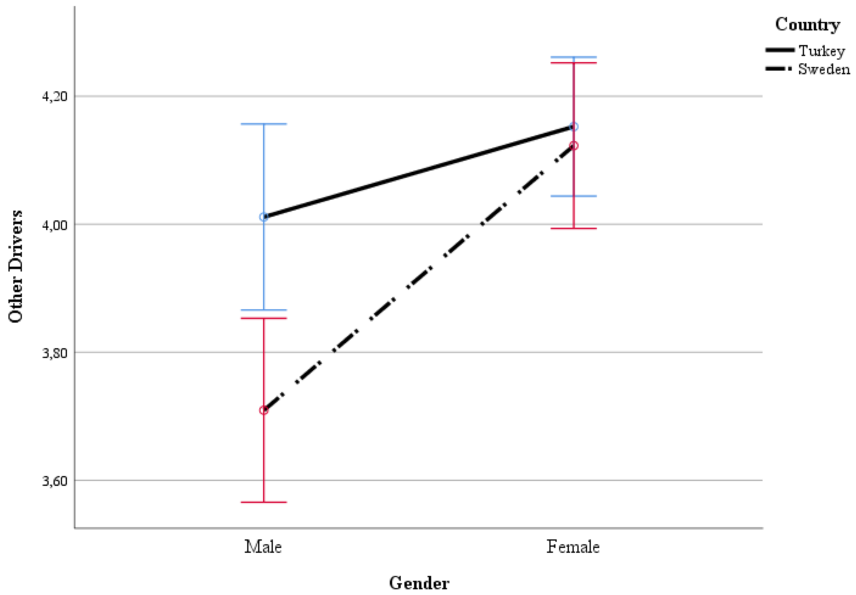

Figure 3. *Gender by Country – Other Drivers*

3.6. Hierarchical Regression Analyses on Automation Preference

In order to test the roles of traffic climate, traffic locus of control and driving skills, six hierarchical regression analyses were conducted. In the first step, age, gender and last year kilometres were entered as control variables. After controlling the statistical effects of demographic variables, the mean of traffic climate, traffic locus of control and driving skills factors were entered into the model separately. Three analyses were performed for samples from Turkey and Sweden. Positive associations indicated preference toward higher levels of automation (see Table 19.).

In Turkey (see Table 19.), the models were significant for traffic climate ($F(6, 296) = 3.12$, $p = .006$), traffic locus of control ($F(8, 294) = 2.09$, $p = .036$) and driving skills ($F(5, 297) = 6.56$, $p < .001$). Among demographic variables, gender (95% CI [-.90, -.16]) and last year kilometres (95% CI [.00, .00]) were negatively related to automation preference. Female drivers and drivers with higher last year kilometres preferred lower levels of automation. Functionality (95% CI [.03, .46]) and safety skills (95% CI [.08, .68]) were positively and perceptual-motor skills (95% CI [-.83, -.24]) was negatively associated with automation preference. Preference toward higher levels of automation was associated with higher functionality, higher safety skills or lower perceptual-motor skills.

Table 19. *Hierarchical Regression Analyses on the Automation Preference for Sample from Turkey*

	Turkey				
Variables	R^2	*df*	*F*Δ	*β*	*p*
1st Step: Demographics	.04	3, 299	4.19		.006
Gender (1: Male, 2: Female)				-.16	.006
Last year kilometres				-.13	.021
Age				.02	.760
2nd Step: Traffic Climate	.06	3, 296	2.01		.112
External Affective Demands				.11	.184
Functionality				.14	.026
Internal Requirements				.01	.867
2nd Step: Traffic Locus of Control	.05	5, 294	.84		.520
Vehicle Environment				-.06	.405
Own Skills				.02	.802
Fate				.10	.104
Other Drivers				.06	.367
Own Behaviours				-.02	.732
2nd Step: Driving Skills	.10	2, 297	9.76		.000
Perceptual-Motor Skills				-.21	.000
Safety Skills				.14	.013

In Sweden (see Table 20.), the models were significant for traffic locus of control (*F*(8, 242) = 2.33, *p* = .020) and driving skills (*F*(5, 245) = 3.74, *p* = .003) and nonsignificant for traffic climate (*F*(6, 244) = 1.58, *p* = .154). Among demographic variables, gender (95% CI [-.84, -.05]) was negatively related to automation preference. Female drivers preferred lower levels of automation. Own skills (95% CI [.06, .49]) was positively, and other drivers (95% CI [-.65, -.03]) and perceptual-motor skills (95% CI [-.98, -.23]) were negatively related to automation preference. Higher own skills, lower other drivers and lower perceptual-motor skills were associated with a higher preference toward upper levels of automation.

Table 20. ***Hierarchical Regression Analyses on the Automation Preference for Sample from Sweden***

	Sweden				
Variables	R^2	*df*	*F*Δ	*β*	*p*
1st Step: Demographics	.03	3, 247	2.59		.053
Gender (1: Male, 2: Female)				-.14	.027
Last year kilometres				.04	.515
Age				.08	.189
2nd Step: Traffic Climate	.04	3, 244	.58		.630
External Affective Demands				-.02	.825
Functionality				.07	.359
Internal Requirements				-.05	.488
2nd Step: Traffic Locus of Control	.07	5, 242	2.14		.061
Vehicle Environment				.04	.597
Own Skills				.18	.013
Fate				.03	.675
Other Drivers				-.17	.030
Own Behaviours				-.01	.892
2nd Step: Driving Skills	.07	2, 245	5.33		.005
Perceptual-Motor Skills				-.21	.002
Safety Skills				-.06	.358

3.7. The Roles of Traffic Climate and Country in Relations between Driving Skills, Traffic Locus of Control and Automation Preference

Eighteen different moderated moderation analyses were conducted by using Hayes PROCESS tool on SPSS with Model 3 to test, after controlling the demographic variables (last year kilometres (C_1), age (C_2) and gender (C_3)), whether the effects of traffic climate (W) in the relationship between traffic locus of control/driving skills (X) and the preferred level of vehicle automation (Y) is the country (Z) dependent. Two independent variables, traffic locus of control (vehicle and environment, own skills, fate, other drivers) and driving skills (perceptual-motor skills, safety skills), two moderators, traffic climate (external affective demands, functionality, internal requirements) and country (1: Turkey, 2: Sweden), were tested. Only own behaviours dimension of traffic locus of control was not included in the model since the factor did not achieve factorial similarity between Turkey and Sweden. As shown in Figure 4, moderator variables were entered into the model as followed, traffic climate as primary moderator and country (1: Turkey, 2: Sweden) as secondary moderator. In line with the conceptual diagram, the following statistical diagram (Figure 5.) were adapted from Hayes (2018, p. 331).

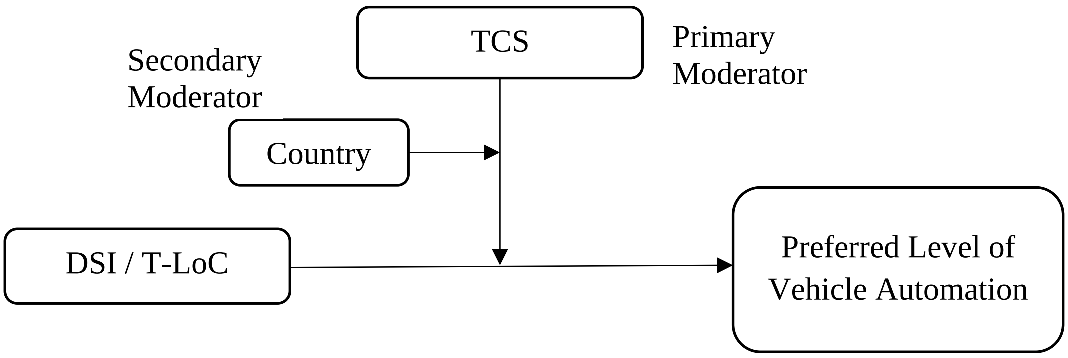

Figure 4. *Conceptual Diagram of Moderated Moderation Analyses*

In this model, b_1 (each dimension of traffic locus of control and driving skills), b_2 (each dimension of traffic climate), and b_3 (country) are conditional effects or simple effects. Each simple effect was computed when both the simple effects of the country and each dimension of other variables, including control variables, were zero. For instance, the simple effect of vehicle and environment was calculated when age, last year kilometres, gender, country and external affective demands were zero. In other words, the effect of vehicle and environment on automation preferences is constrained to be the same for all ages, male and female, all last year kilometres, both Turkey and Sweden and all levels of external affective demands. b_4 is the conditional interaction between traffic locus of control/driving skills and traffic climate when the country is zero. b_5 is the conditional interaction between traffic locus of control/driving skills and country when traffic climate is zero. b_6 is the conditional interaction between traffic climate and country when traffic locus of control/driving skills is zero. Finally, b_7 is the three-way interaction term.

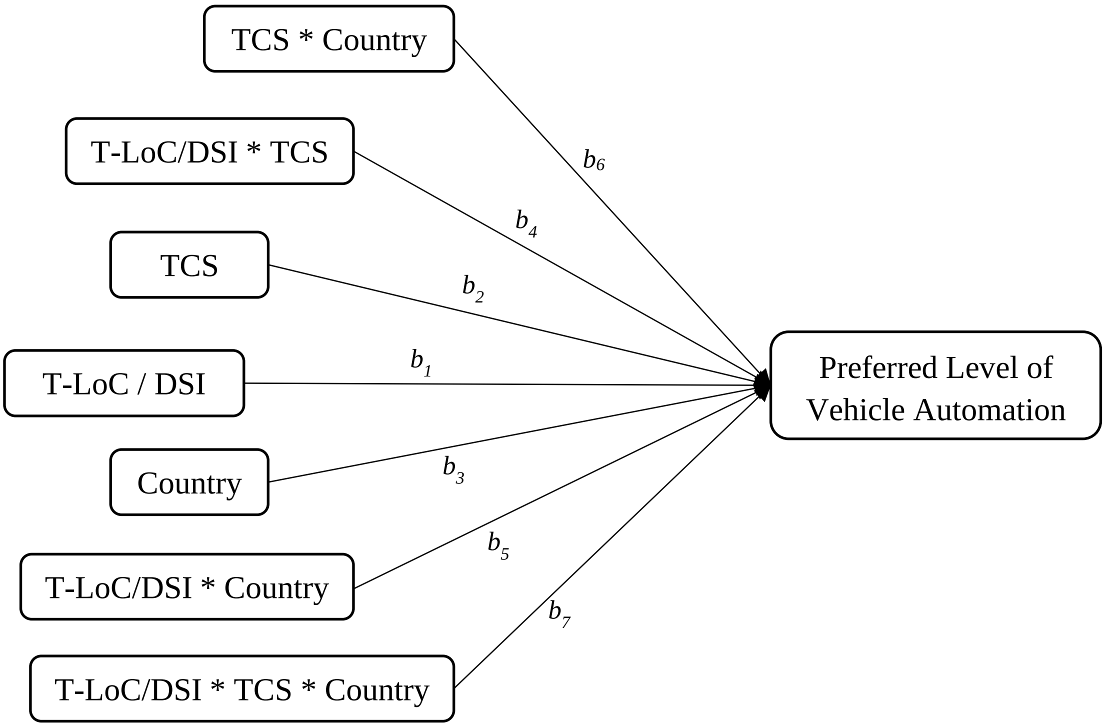

Figure 5. *Statistical Diagram of Moderated Moderation Analyses*

Among the eighteen moderated moderation analyses, all models were significant (see Table 21.). Total variance explained by the models ranged between 4% and 9%.

Table 21. ***The Model Summaries of Moderated Moderation Analyses***

Model	F(10, 543)	R^2	p
1. VE*EAD*Country	2.72	0.05	.003
2. OS*EAD*Country	2.97	0.05	.001
3. F*EAD*Country	2.54	0.05	.005
4. OD*EAD*Country	2.70	0.05	.003
5. PMS*EAD*Country	5.02	0.09	.000
6. SS*EAD*Country	3.86	0.07	.000
7. VE*FUN*Country	2.76	0.05	.002
8. OS*FUN*Country	3.58	0.06	.000

Table 21. ***continued.***

Model	$F(10, 543)$	R^2	*p*
9. F*FUN*Country	2.69	0.05	.003
10. OD*FUN*Country	3.36	0.06	.000
11. PMS*FUN*Country	5.61	0.09	.000
12. SS*FUN*Country	3.48	0.06	.000
13. VE*IR*Country	2.78	0.05	.002
14. OS*IR*Country	3.55	0.06	.000
15. F*IR*Country	2.50	0.04	.006
16. OD*IR*Country	3.56	0.06	.000
17. PMS*IR*Country	5.04	0.09	.000
18. SS*IR*Country	2.93	0.05	.001

Note. EAD: External affective demands, FUN: Functionality, IR: Internal requirements, VE: Vehicle and environment, OS: Own skills, F: Fate, OD: Other drivers, OB: Own behaviours, PMS: Perceptual-motor skills, SS: Safety skills, Country (1: Turkey, 2: Sweden).

In Model 1 (see Table 22.), the simple effects of external affective demands ($b_2 = 2.36$, $t(543) = 2.04$, $p = .041$), country ($b_3 = 5.14$, $t(543) = 1.84$, $p = .066$) and gender ($C_3 = -.48$, $t(543) = -3.41$, $p = .001$) were significant. The two-way interactions between vehicle and environment and external affective demands ($b_4 = -.52$, $t(543) = -1.83$, $p = .067$), vehicle and environment and country ($b_5 = -1.25$, $t(543) = -1.77$, $p = .077$) and external affective demands and country ($b_6 = -1.68$, $t(543) = -2.26$, $p = .024$) were significant. The three-way interaction was also significant ($b_7 = .38$, $t(543) = 2.04$, $p = .042$). The three-way interactions is significant only in the Swedish sample ($b = .24$, $F(1, 543) = 2.98$, $p = .085$). The relationship was positively significant only at high external affective demands ($b = .49$, $t(543) = 1.69$, $p = .092$, 95% CI [-.08, 1.06]). In Sweden, vehicle and environment was positively associated with the preference toward higher levels of automation when external affective demands perceived to be high. In other words, when the traffic system is externally demanding, drivers from Sweden with higher vehicle and environment factors also preferred vehicles with higher levels of automation (see Figure 6.).

Table 22. ***Conditional effect(s) of vehicle and environment on the drivers' automated vehicle preferences at external affective demands and country***

Variable	*b*	*se*	*t*	*p*	95% CI
VE	1.81	1.19	1.52	.129	-.53, 4.15
EAD	2.36	1.16	2.04	.042	.09, 4.63
VE * EAD	-.52	.29	-1.83	.067	-1.09, .04
Country	5.14	2.79	1.84	.066	-.33, 10.62
VE * Country	-1.25	.71	-1.77	.077	-2.64, .13
EAD * Country	-1.68	.74	-2.26	.024	-3.14, -.22
VE * EAD * Country	.38	.19	2.04	.042	.01, .75
Last year kilometres	.00	.00	-1.11	.269	.00, .00
Age	.02	.01	1.41	.161	-.01, .04
Gender	-.48	.14	-3.41	.001	-.75, -.20

Note. VE: Vehicle and Environment, EAD: External affective demands, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

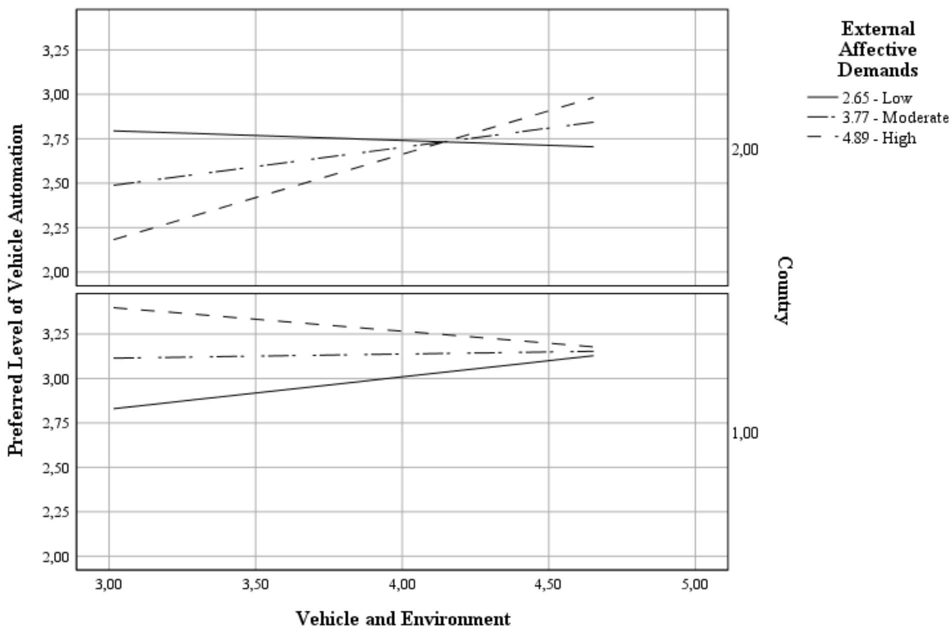

Figure 6. *Three-Way Interactions between VE, EAD and Country*

In Model 2 (see Table 23.), the simple effect of gender (C_3 = -.49, $t(543) = -3.57$, $p < .001$) was significant.

In Model 3 (see Table 24.), the simple effect of gender (C_3 = -.50, $t(543) = -3.59$, $p < .001$) was significant.

Table 23. ***Conditional effect(s) of own skills on the drivers' automated vehicle preferences at external affective demands and country***

Variable	*b*	*se*	*t*	*p*	95% CI
OS	.65	.99	.66	.509	-1.29, 2.59
EAD	.90	.75	1.19	.234	-.58, 2.38
OS * EAD	-.20	.23	-.86	.390	-.66, .26
Country	.98	1.87	.52	.601	-2.70, 4.66
OS * Country	-.22	.59	-.38	.704	-1.38, .93
EAD * Country	-.49	.49	-1.01	.312	-1.45, .46
OS * EAD * Country	.11	.16	.67	.501	-.20, .41
Last year kilometres	.00	.00	-1.14	.257	.00, .00
Age	.02	.01	1.44	.149	-.00, .04
Gender	-.49	.14	-3.57	.000	-.76, -.22

Note. OS: Own skills, EAD: External affective demands, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

Table 24. ***Conditional effect(s) of fate on the drivers' automated vehicle preferences at external affective demands and country***

Variable	*b*	*se*	*t*	*p*	95% CI
F	-.44	1.01	-.44	.661	-2.43, 1.54
EAD	.01	.66	.02	.987	-1.28, 1.30
F * EAD	.13	.24	.55	.582	-.33, .59
Country	-.06	1.74	-.03	.973	-3.47, 3.35
F * Country	.16	.61	.27	.788	-1.04, 1.37
EAD * Country	-.13	.49	-.28	.783	-1.09, .82
F * EAD * Country	-.04	.16	-.25	.801	-.35, .27
Last year kilometres	.00	.00	-1.04	.300	.00, .00
Age	.02	.01	1.59	.113	-.00, .04
Gender	-.50	.14	-3.59	.000	-.77, -.23

Note. F: Fate, EAD: External affective demands, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 4 (see Table 25.), the simple effects of country (b_3 = 5.27, $t(543)$ = 1.80, p = .073) and gender (C_3 = -.45, $t(543)$ = -3.24, p = .001) were significant. The two-way interactions between other drivers and country (b_5 = -1.25, $t(543)$ = -1.76, p = .079) and external affective demands and country (b_6 = -1.44, $t(543)$ = -1.76, p = .078) were significant.

Table 25. ***Conditional effect(s) of other drivers on the drivers' automated vehicle preferences at external affective demands and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
OD	1.66	1.15	1.44	.151	-.61, 3.93
EAD	1.87	1.20	1.55	.121	-.49, 4.22
OD * EAD	-.39	.29	-1.36	.174	-.96, .17
Country	5.27	2.93	1.80	.073	-.49, 11.04
OD * Country	-1.25	.71	-1.76	.079	-2.65, .14
EAD * Country	-1.44	.82	-1.77	.078	-3.05, .16
OD * EAD * Country	.31	.20	1.59	.113	-.07, .69
Last year kilometres	.00	.00	-.77	.441	.00, .00
Age	.02	.01	1.52	.130	-.00, .04
Gender	-.45	.14	-3.24	.001	-.73, -.18

Note. OD: Other drivers, EAD: External affective demands, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 5 (see Table 26.), the simple effects of age (C_2 = .02, $t(543) = 1.70$, $p = .090$) and gender (C_3 = -.65, $t(543) = -4.65$, $p < .001$) were significant.

Table 26. ***Conditional effect(s) of perceptual-motor skills on the drivers' automated vehicle preferences at external affective demands and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
PMS	-1.85	1.61	-1.15	.251	-5.00, 1.31
EAD	-.53	1.42	-.37	.711	-3.32, 2.26
PMS * EAD	.22	.39	.57	.569	-.54, .99
Country	-1.09	3.68	-.29	.768	-8.32, 6.15
PMS * Country	.37	1.00	.37	.709	-1.60, 2.34
EAD * Country	-.11	1.03	-.11	.915	-2.14, 1.92
PMS * EAD * Country	-.02	.28	-.08	.935	-.57, .53
Last year kilometres	.00	.00	-.11	.915	.00, .00
Age	.02	.01	1.70	.090	.00, .04
Gender	-.65	.14	-4.65	.000	-.92, -.37

Note. PMS: Perceptual-motor skills, EAD: External affective demands, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 6 (see Table 27.), the simple effects of safety skills (b_1 = 5.37, $t(543) = 3.12$, $p = .002$), external affective demands (b_2 = 4.67, $t(543) = 2.88$, $p = .004$), country (b_3 = 13.51, $t(543) = 3.30$, $p = .001$) and gender (C_3 = -.48, $t(543) = -3.46$, $p = .001$) were significant. The two-way interactions between safety skills and external affective demands (b_4 = -1.14, t(543) = -2.79, p = .006), safety skills and country (b_5 = -3.44, t(543) = -3.30, p = .001) and external affective demands and country (b_6 = -3.23, t(543) = -3.03, p = .003) were significant. The three-way interaction was also significant (b_7 = .79, t(543) = 2.89, p = .004). The interactions of safety skills and external affective demands on the automation preference were significant for both samples from Turkey (b = -.34, F(1, 543) = 3.87, p = .05) and Sweden (b = .45, F(1, 543) = 4.52, p = .034) samples. The relationship was positively significant on low (b = 1.02, t(1, 543) = 2.90, p = .004) and moderate (b = .64, t(1, 543) = 3.24, p = .001) levels of external affective demands in sample from Turkey and positively significant on high (b = .70, t(1, 543) = 1.66, p = .096) levels of external affective demands in sample from Sweden. There were significant positive effects of safety skills on the automation preference when the external affective demands was low or moderate in Turkey and high in Sweden. In other words, in Turkey, for drivers who perceive the traffic system low and moderate in terms of external affective demands, safety skills was positively associated with preference toward higher levels of automation. On the other hand, in Sweden, safety skills was positively associated with automated driving preference only when the traffic climate was perceived to be high in terms of external affective demands (see Figure 7.).

Table 27. ***Conditional effect(s) of safety skills on the drivers' automated vehicle preferences at external affective demands and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
SS	5.37	1.72	3.12	.002	1.98, 8.76
EAD	4.67	1.62	2.88	.004	1.49, 7.86
SS * EAD	-1.14	.41	-2.79	.006	-1.94, -.34
Country	13.51	4.10	3.30	.001	5.46, 21.56
SS * Country	-3.44	1.04	-3.30	.001	-5.49, -1.39
EAD * Country	-3.23	1.07	-3.03	.003	-5.33, -1.14
SS * EAD * Country	.79	.27	2.89	.004	.25, 1.33
Last year kilometres	.00	.00	-.60	.547	.00, .00
Age	.01	.01	1.36	.174	-.01, .04
Gender	-.48	.14	-3.46	.001	-.75, -.21

Note. SS: Safety skills, EAD: External affective demands, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

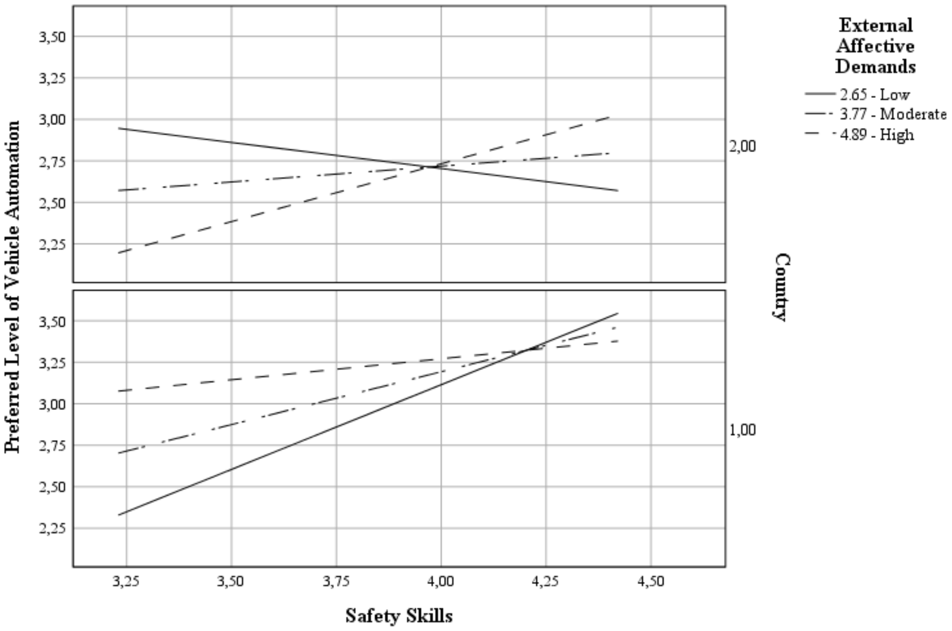

Figure 7. *Three-Way Interactions between SS, EAD and Country*

In Model 7 (see Table 28.), the simple effects of country (b_3 = -5.46, $t(543)$ = -1.89, p = .059), age (C_2 = .02, $t(543)$ = 1.74, p = .083) and gender (C_3 = -.50, $t(543)$ = -3.53, p < .001) were significant. The two-way interaction between vehicle and environment and country (b_5 = 1.27, $t(543)$ = 1.75, p = .080) was significant. The three-way interaction was also significant (b_7 = -.33, $t(543)$ = -1.72, p = .087). However, none of the comparisons were significantly different (see Figure 8.).

Table 28. ***Conditional effect(s) of vehicle and environment on the drivers' automated vehicle preferences at functionality and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
VE	-1.70	1.04	-1.63	.103	-3.75, .34
FUN	-1.64	1.21	-1.35	.177	-4.02, .74
VE * FUN	.46	.30	1.55	.123	-.12, 1.05
Country	-5.46	2.88	-1.89	.059	-11.13, .20
VE * Country	1.27	.73	1.75	.080	-.15, 2.70
FUN * Country	1.27	.78	1.64	.101	-.25, 2.80
VE * FUN * Country	-.33	.19	-1.72	.087	-.72, .05
Last year kilometres	.00	.00	-1.04	.298	.00, .00
Age	.02	.01	1.74	.083	.00, .04
Gender	-.50	.14	-3.53	.000	-.77, -.22

Note. VE: Vehicle and Environment, FUN: Functionality, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

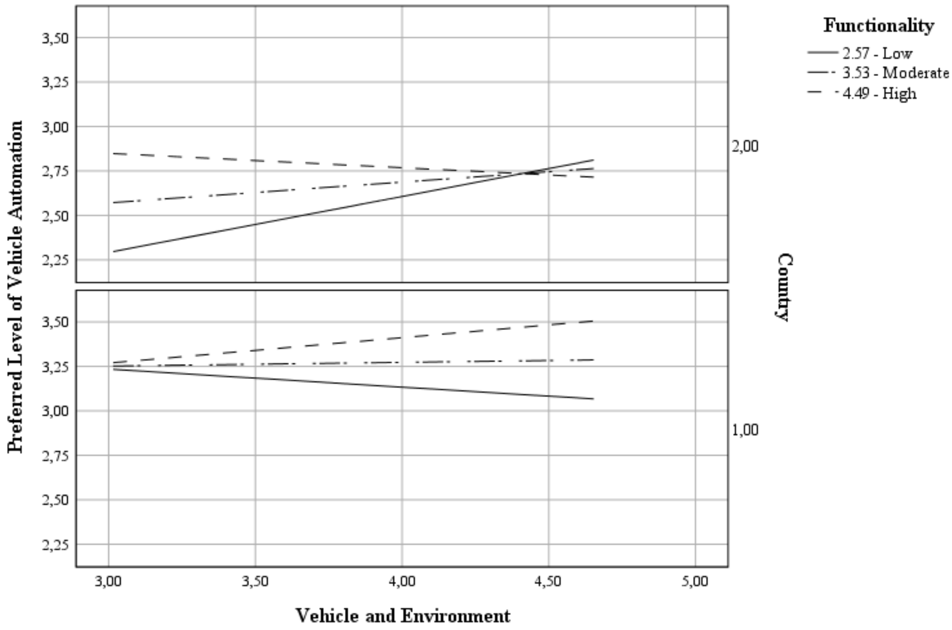

Figure 8. *Three-Way Interactions between VE, FUN and Country*

In Model 8 (see Table 29.), the simple effects of own skills (b_1 = -1.73, t(543) = -2.43, p = .015), functionality (b_2 = -1.11, t(543) = -1.65, p = .100), country (b_3 = -4.52, t(543) = -2.62, p = .009), age (C_2 = .02, t(543) = 1.65, p = .099) and gender (C_3 = -.49, t(543) = -3.62, p < .001) were significant. The two-way interactions between own skills and functionality (b_4 = .43, t(543) = 2.11, p = .036), own skills and country (b_5 = 1.39, t(543) = 2.58, p = .010) and functionality and country (b_6 = .90, t(543) = 1.98, p = .049) were significant. The three-way interaction was also significant (b_7 = -.31, t(543) = -2.24, p = .026). The interaction effect of own skills and functionality was only significant in sample from Sweden (b = -.20, F(1, 543) = 3.19, p = .075). In Sweden, the relationship was positively significant at low (b = .54, t(1, 543) = 2.76, p = .006) and moderate (b = .35, t(1, 543) = 3.03, p = .003) levels of functionality (Figure 9.). In Sweden, own skills was significantly positively related to automation preferences when functionality is at the low and moderate level.

Table 29. ***Conditional effect(s) of own skills on the drivers' automated vehicle preferences at functionality and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
OS	-1.73	.71	-2.43	.015	-3.12, -.33
FUN	-1.11	.68	-1.65	.100	-2.44, .21
OS * FUN	.43	.20	2.11	.036	.03, .82

Table 29. ***continued.***

Variable	*b*	*se*	*t*	*p*	95% CI
Country	-4.52	1.72	-2.62	.009	-7.90, -1.13
OS * Country	1.39	.54	2.58	.010	.33, 2.45
FUN * Country	.90	.46	1.98	.049	.01, 1.80
OS * FUN * Country	-.31	.14	-2.24	.026	-.59, -.04
Last year kilometres	.00	.00	-1.19	.233	.00, .00
Age	.02	.01	1.65	.099	-.00, .04
Gender	-.49	.14	-3.62	.000	-.76, -.23

Note. OS: Own skills, FUN: Functionality, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

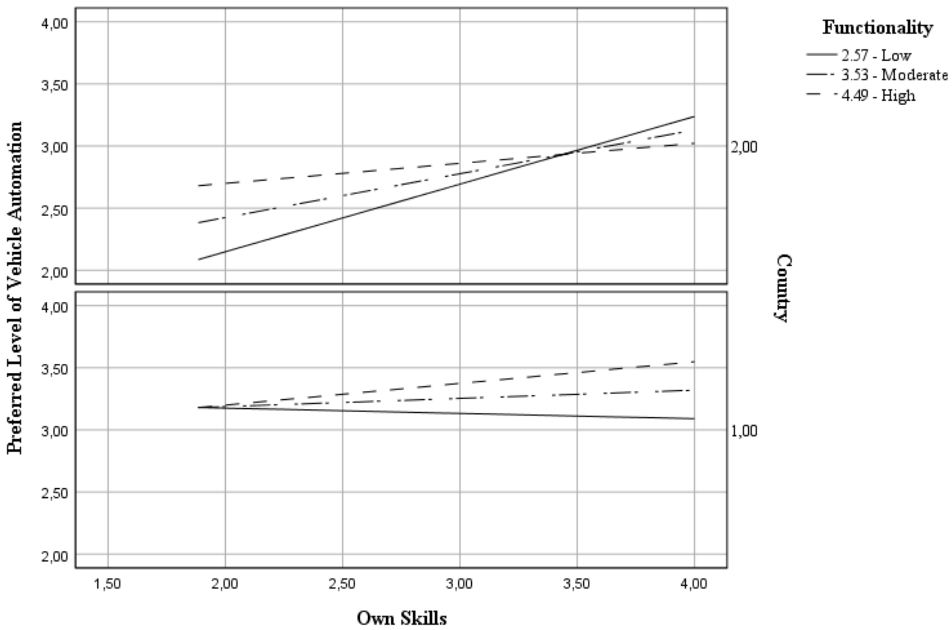

Figure 9. *Three-Way Interactions between OS, FUN and Country*

In Model 9 (see Table 30.), the simple effects of age (C_2 = .02, $t(543) = 1.75$, $p = .081$) and gender (C_3 = -.51, $t(543) = -3.61$, $p < .001$) were significant.

Table 30. ***Conditional effect(s) of fate on the drivers' automated vehicle preferences at functionality and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
F	-.33	.81	-.40	.688	-1.92, 1.27
FUN	-.29	.66	-.44	.660	-1.58, 1.00
F * FUN	.17	.23	.75	.456	-.28, .63
Country	-.93	1.82	-.51	.609	-4.50, 2.64
F * Country	.14	.59	.24	.807	-1.01, 1.30

Table 30. ***continued.***

Variable	*b*	*se*	*t*	*p*	95% CI
FUN * Country	.18	.47	.39	.697	-.74, 1.11
F * FUN * Country	-.08	.16	-.50	.618	-.38, .23
Last year kilometres	.00	.00	-1.03	.303	.00, .00
Age	.02	.01	1.75	.081	-.00, .04
Gender	-.51	.14	-3.61	.000	-.78, -.23

Note. F: Fate, FUN: Functionality, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 10 (see Table 31.), the simple effects of other drivers (b_1 = -2.28, $t(543)$ = -2.06, p = .040), functionality (b_2 = -2.90, $t(543)$ = -2.18, p = .030), country (b_3 = -7.69, $t(543)$ = -2.33, p = .020), age (C_2 = .02, $t(543)$ = 2.00, p = .046), and gender (C_3 = -.45, $t(543)$ = -3.23, p = .001) were significant. The two-way interactions between other drivers and functionality (b_4 = .73, $t(543)$ = 2.36, p = .019), other drivers and country (b_5 = 1.71, $t(543)$ = 2.19, p = .029) and functionality and country (b_6 = 2.18, $t(543)$ = 2.50, p = .013) were significant. The three-way interaction was also significant (b_7 = -.53, $t(543)$ = -2.57, p = .010). The interaction effect of other drivers and functionality was only significant in Swedish sample (b = -.32, $F(1, 543)$ = 4.35, p = .038). In Sweden, the relationship was negatively significant at high (b = -.32, $t(1, 543)$ = -2.16, p = .032) levels of functionality (Figure 10.). In Sweden, other drivers was significantly negatively related to automation preferences when functionality is high.

Table 31. ***Conditional effect(s) of other drivers on the drivers' automated vehicle preferences at functionality and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
OD	-2.28	1.11	-2.06	.040	-4.47, -.10
FUN	-2.90	1.33	-2.18	.030	-5.51, -.29
OD * FUN	.73	.31	2.36	.019	.12, 1.35
Country	-7.69	3.31	-2.33	.020	-14.19, -1.19
OD * Country	1.71	.78	2.19	.029	.17, 3.24
FUN * Country	2.18	.87	2.50	.013	.47, 3.89
OD * FUN * Country	-.53	.21	-2.57	.010	-.93, -.13
Last year kilometres	.00	.00	-.94	.350	.00, .00
Age	.02	.01	2.00	.046	.00, .04
Gender	-.45	.14	-3.23	.001	-.73, -.18

Note. OD: Other drivers, FUN: Functionality, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

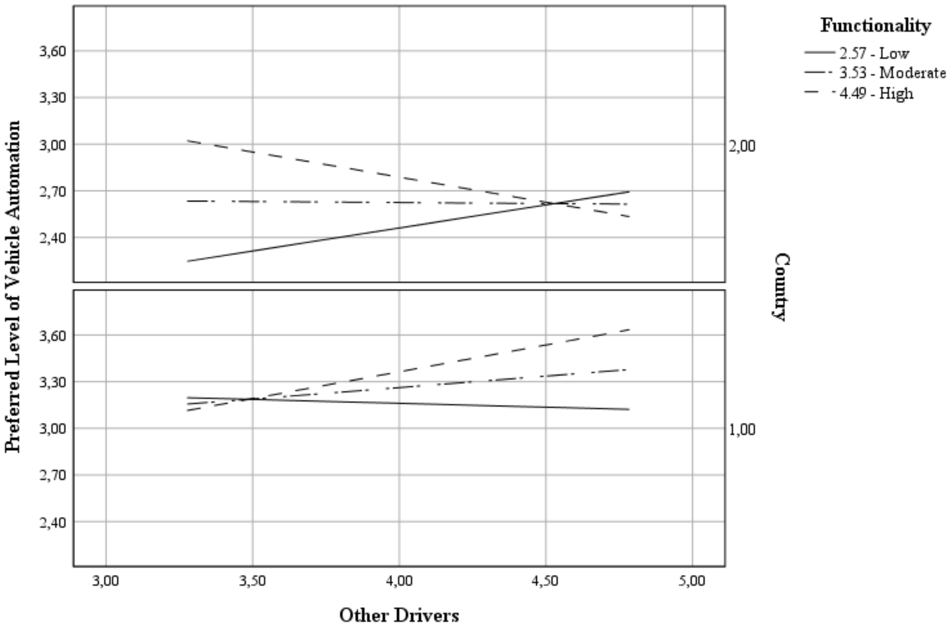

Figure 10. *Three-Way Interactions between OD, FUN and Country*

In Model 11 (see Table 32.), the simple effects of age (C_2 = .02, $t(543) = 1.88$, p = .061), and gender (C_3 = -.71, $t(543) = -5.09$, $p < .001$) were significant.

Table 32. *Conditional effect(s) of perceptual-motor skills on the drivers' automated vehicle preferences at functionality and country.*

Variable	*b*	*se*	*t*	*p*	95% CI
PMS	.32	1.45	.22	.826	-2.54, 3.17
FUN	1.00	1.43	.70	.484	-1.81, 3.81
PMS * FUN	-.19	.39	-.49	.627	-.96, .58
Country	4.43	4.32	1.02	.306	-4.06, 12.92
PMS * Country	-1.28	1.17	-1.09	.275	-3.58, 1.02
FUN * Country	-1.17	1.09	-1.07	.283	-3.32, .97
PMS * FUN * Country	.30	.30	1.00	.317	-.28, .88
Last year kilometres	.00	.00	-.21	.830	.00, .00
Age	.02	.01	1.88	.061	.00, .04
Gender	-.71	.14	-5.09	.000	-.98, -.43

Note. PMS: Perceptual-motor skills, FUN: Functionality, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 12 (see Table 33.), the simple effects of age (C_2 = .02, $t(543) = 1.65$, p = .100) and gender (C_3 = -.50, $t(543) = -3.65$, $p < .001$) were significant.

Table 33. ***Conditional effect(s) of safety skills on the drivers' automated vehicle preferences at functionality and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
SS	.84	1.33	.63	.529	-1.77, 3.44
FUN	.28	1.57	.18	.861	-2.80, 3.35
SS * FUN	-.01	.39	-.01	.990	-.77, .76
Country	-.20	3.54	-.06	.956	-7.14, 6.75
SS * Country	-.03	.91	-.04	.970	-1.83, 1.76
FUN * Country	.38	.99	.38	.705	-1.58, 2.33
SS * FUN * Country	-.12	.25	-.46	.645	-.61, .38
Last year kilometres	.00	.00	-.83	.407	.00, .00
Age	.02	.01	1.65	.100	.00, .04
Gender	-.50	.14	-3.65	.000	-.77, -.23

Note. SS: Safety skills, FUN: Functionality, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 13 (see Table 34.), the simple effect of gender (C_3 = -.48, $t(543) = -3.41$, $p <$ .001) were significant.

Table 34. ***Conditional effect(s) of vehicle and environment on the drivers' automated vehicle preferences at internal requirements and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
VE	-.21	1.49	-.14	.889	-3.14, 2.72
IR	.17	1.17	.14	.885	-2.13, 2.47
VE * IR	.05	.30	.17	.863	-.53, .64
Country	-1.93	3.33	-.58	.563	-8.47, 4.61
VE * Country	.72	.88	.81	.417	-1.02, 2.45
IR * Country	.35	.70	.50	.617	-1.03, 1.73
VE * IR * Country	-.16	.18	-.89	.376	-.52, .20
Last year kilometres	.00	.00	-.80	.422	.00, .00
Age	.02	.01	1.61	.109	.00, .04
Gender	-.48	.14	-3.41	.001	-.76, -.20

Note. VE: Vehicle and Environment, IR: Internal requirements, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 14 (see Table 35.), the simple effect of gender (C_3 = -.49, $t(543) = -3.56$, $p <$ .001) were significant.

Table 35. ***Conditional effect(s) of own skills on the drivers' automated vehicle preferences at internal requirements and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
OS	-.25	1.57	-.16	.874	-3.33, 2.84
IR	.21	.93	.23	.820	-1.61, 2.03
OS * IR	.04	.30	.15	.883	-.54, .63
Country	-1.66	2.72	-.61	.543	-7.01, 3.69
OS * Country	.83	.89	.94	.350	-.92, 2.59
IR * Country	.20	.53	.36	.716	-.86, 1.25
OS * IR * Country	-.15	.17	-.87	.385	-.50, .19
Last year kilometre	.00	.00	-1.13	.261	.00, .00
Age	.02	.01	1.52	.128	.00, .04
Gender	-.49	.14	-3.56	.000	-.76, -.22

Note. OS: Own skills, IR: Internal requirements, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 15 (see Table 36.), the simple effect of gender (C_3 = -.50, $t(543) = -3.56$, $p <$ .001) were significant.

Table 36. ***Conditional effect(s) of fate on the drivers' automated vehicle preferences at internal requirements and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
F	-.91	1.44	-.63	.527	-3.75, 1.92
IR	-.36	.75	-.48	.630	-1.82, 1.11
F * IR	.23	.28	.84	.401	-.31, .78
Country	-1.57	2.40	-.65	.513	-6.29, 3.15
F * Country	.70	.88	.80	.427	-1.02, 2.42
IR * Country	.28	.49	.57	.568	-.68, 1.24
F * IR * Country	-.17	.18	-.94	.346	-.51, .18
Last year kilometres	.00	.00	-1.01	.313	.00, .00
Age	.02	.01	1.48	.139	-.01, .04
Gender	-.50	.14	-3.56	.000	-.78, -.22

Note. F: Fate, IR: Internal requirements, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 16 (see Table 37.), the simple effects of age (C_2 = .02, $t(543) = 1.99$, p = .047) and gender (C_3 = -.44, $t(543) = -3.17$, p = .002) were significant.

Table 37. ***Conditional effect(s) of other drivers on the drivers' automated vehicle preferences at internal requirements and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
OD	.42	1.57	.27	.790	-2.66, 3.50
IR	-.10	1.26	-.08	.937	-2.57, 2.37
OD * IR	.04	.32	.14	.891	-.58, .66
Country	-2.91	3.77	-.77	.441	-10.31, 4.49
OD * Country	.67	.95	.70	.482	-1.20, 2.55
IR * Country	.94	.81	1.15	.250	-.66, 2.53
OD * IR * Country	-.25	.20	-1.23	.221	-.64, .15
Last year kilometres	.00	.00	-.69	.492	.00, .00
Age	.02	.01	1.99	.047	.00, .04
Gender	-.44	.14	-3.17	.002	-.72, -.17

Note. OD: Other drivers, IR: Internal requirements, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 17 (see Table 38.), the simple effect of gender (C_3 = -.65, $t(543) = -4.60$, $p < .001$) were significant.

Table 38. ***Conditional effect(s) of perceptual-motor skills on the drivers' automated vehicle preferences at internal requirements and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
PMS	-1.30	2.34	-.56	.577	-5.89, 3.28
IR	-.04	1.62	-.02	.981	-3.21, 3.14
PMS * IR	.09	.45	.21	.836	-.79, .97
Country	1.23	4.97	.25	.805	-8.53, 10.99
PMS * Country	-.18	1.36	-.13	.894	-2.85, 2.49
IR * Country	-.49	1.01	-.48	.628	-2.47, 1.49
PMS * IR * Country	.08	.27	.29	.775	-.46, .62
Last year kilometres	.00	.00	.02	.984	.00, .00
Age	.02	.01	1.52	.128	-.00, .04
Gender	-.65	.14	-4.60	.000	-.93, -.37

Note. PMS: Perceptual-motor skills, IR: Internal requirements, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

In Model 18 (see Table 39.), the simple effect of gender (C_3 = -.49, $t(543) = -3.50$, $p = .001$) were significant.

Table 39. ***Conditional effect(s) of safety skills on the drivers' automated vehicle preferences at internal requirements and country.***

Variable	*b*	*se*	*t*	*p*	95% CI
SS	-.43	2.24	-.19	.850	-4.83, 3.98
IR	-.95	1.68	-.56	.574	-4.25, 2.36
SS * IR	.27	.44	.62	.537	-.59, 1.14
Country	-1.59	5.12	-.31	.756	-11.65, 8.46
SS * Country	.40	1.35	.30	.766	-2.25, 3.06
IR * Country	.64	1.06	.61	.545	-1.44, 2.73
SS * IR * Country	-.19	.28	-.68	.497	-.74, .36
Last year kilometres	.00	.00	-.78	.439	.00, .00
Age	.02	.01	1.46	.144	-.01, 04
Gender	-.49	.14	-3.50	.001	-.76, -.21

Note. SS: Safety skills, IR: Internal requirements, Country: 1 (Turkey) 2 (Sweden), Gender: 1 (Male) 2 (Female).

CHAPTER 4

DISCUSSION

4.1. Overview

The present study focuses on gender and country differences in the preferred level of vehicle automation and the relations of traffic climate, traffic locus of control and driving skills with the drivers' automated vehicle preferences across Turkey and Sweden. In line with this aim, first of all, sample characteristics, factorial structures and congruity of the measurements were tested. Following that, separately for Turkey and Sweden, correlations, gender-based and country-based differences were examined. Finally, after testing individual relations of traffic climate, traffic locus of control and driving skills with the drivers' automated vehicle preferences via hierarchical regression analyses, moderated moderation analyses were conducted in order to examine the relations of driving skills and traffic locus of control on the most preferred level of automation by traffic climate on the two countries. In the following session, factorial structures, descriptive and correlations, gender and country differences and relations of the variables with the drivers' automation preferences were discussed. In light of the results and literature, limitations, implications and suggestions for future suggestions were highlighted.

4.2. Summary and Discussion of the Results

4.2.1. Factorial Structure of the Measurements

Six principal component analyses were conducted to examine factorial structures of TCS, T-LoC and DSI in Turkey and Sweden. Following the factorial analyses, the rotated factor matrices using Procrustes target rotation technique and factorial agreement coefficients were compared to examine the factorial agreement between

Turkey and Sweden. For the measurement of traffic climate of a country, Üzümcüoğlu et al. (2020b) suggested a short and user-friendly version of the Traffic Climate Scale with better psychometric properties. In the present study, even though data was collected with the long 44 items version, considering the item differences within factors in different studies and countries (Gehlert et al., 2014; Üzümcüoğlu Zihni, 2018; Üzümcüoğlu et al., 2019; Üzümcüoğlu et al., 2020b) and psychometric properties of various version (Üzümcüoğlu et al., 2020b), the short, sixteen items, version had been used. In terms of the factorial structure of the short version, the three-factor structure of the scale was supported. In Sweden, the items loaded in the corresponding factor similar to the study of Üzümcüoğlu et al. (2020b).

On the other hand, in Turkey, three items (*aggressive*, *stressful*, *chaotic*) loaded in internal requirements dimensions contrary to loading in external affective demands (Üzümcüoğlu et al., 2020b). It was especially surprising that two of the items (*stressful* and *chaotic*) that were thought to be the core items of external affective demands (Üzümcüoğlu et al., 2020b) loaded into internal requirements factor in Turkey. In agreement with the aim of the scale, the difference may be because of either the characteristics of the sample, characteristics of the traffic system of Turkey or the interaction between the road users and the traffic system. In other words, by looking at the numbers of road safety (TUIK, 2018) and road users' evaluation of the traffic system in Turkey (Üzümcüoğlu Zihni, 2018), it could be suggested that the traffic system in Turkey is relatively dangerous. In a hazardous traffic system, relatively inexperienced drivers such as the sample of the present study may feel aggression or stress as internal characteristics rather than the general external demands coming from the traffic system (The mean ages of participants were 22.41 from Turkey and 28.8 for Sweden in the present study and 27.77 for Turkey in the study of Üzümcüoğlu et al. (2020b)). Because of this difference, items may be loaded into different factors from Sweden and previous studies (Üzümcüoğlu et al., 2020b). Overall, it could be suggested that the short version of the Traffic Climate Scale showed a good factorial structure with acceptable internal consistency and could be used to assess the road users' perception of the traffic system of Sweden.

The factorial analyses on the Traffic Locus of Control Scale with the five factors solution showed acceptable internal consistency reliabilities except for the own behaviours dimension in Turkey. Besides, some of the items showed factorial differences between countries and previous Turkish (Özkan & Lajunen, 2005) and Swedish (Wallén Warner et al., 2010) studies. Similar to the study of Wallén Warner et al. (2010), even though there were certain items loaded into different factors in two countries, self and other driver versions of the two items, "*Shortcomings in [either own or others] driving skills*" and "*[either own or others] risk-taking while driving*" were found to be the items with the highest loading for own skills and other drivers dimensions. These items could be the core items for attributing accidents to self or other drivers.

Moreover, the original three items (*coincidence*, *fate* and *bad luck*) of the fate factor (Özkan & Lajunen, 2005) were loaded in the same factor both in Turkey and Sweden. Besides, in Sweden, "dangerous roads" was also seen as a fate related factor with the lowest loading among the four items. Similarly, in the previous study conducted in Sweden (Wallén Warner et al., 2010), dangerous roads loaded in fate factors with .31 and vehicle and environment factor with .47 loadings. It could be suggested that accidents due to hazardous roads could be seen as either fate or environmental factor in Sweden. The own behaviours dimension consisted of the same three items (*I often drive with too high speed, I drive too close to the car in front,* and *My own dangerous overtaking*) in the previous study conducted in Sweden (Wallén Warner et al., 2010). However, only "*I drive too close to the car in front*" item was common between Sweden and Turkey. Moreover, the dimension is the only dimension showing factorial incongruity between Turkey and Sweden according to the target rotation and agreement coefficients. It would be essential to consider the incongruity and low Cronbach's alpha reliability in Turkey while considering the results of the present study. Finally, "*Other drivers' driving under the influence of alcohol*" and "*Other drivers' dangerous overtaking*" and "*Other drivers often drive with too high speed*" items were loaded into vehicle and environment factors even though the wording of the items included other behaviours. However, similar issues had been reported in previous studies (Özkan & Lajunen, 2005; Wallén Warner et al., 2010) regarding these items. For instance, Özkan and Lajunen (2005) also found the items cross-loading into the vehicle and environment factor in addition to the other drivers factor. It might be discussed that even though these items focus on the behaviours of other drivers, these behaviours were observed in the traffic setting. Because of these behaviours, the traffic environment may be perceived to be riskier or chaotic. That is why these items may be associated with the environment part of the vehicle and environment factor.

In terms of the factorial structure of the Driving Skills Inventory, the measurement showed a clear factor structure with high item loadings and acceptable internal consistency reliability both in Turkey and Sweden. Three factors for Turkey and five factors for Sweden had eigenvalues over 1. However, consistent with the theoretical framework of driving skills (Lajunen & Summala, 1995) and studies in different countries (Ostapczuk et al., 2017; Wallén Warner et al., 2013), two factors across the two countries were the most appropriate factor solution.

In terms of the item structure between the two countries, three differences were detected. First, the item "*Tolerating other drivers' errors calmly*" was loaded into perceptual-motor skills in Turkey and safety skills in Sweden. The difference might be because of the content of the item. In the Swedish version, the item included "*calmly*" expression (Wallén Warner et al., 2013). However, in the Turkish version used in the present study and previous studies (Bıçaksız, 2015; Erkuş, 2017), the "*calmly*" part was not used. Tolerating and calmly expression can be interpreted as either perceptual-motor skills for drivers who can compensate for the errors of other drivers or safety skills for drivers who can continue driving calmly and safely despite the errors of other drivers. Therefore, the possible different interpretations of the statement by the drivers of two countries may indicate that ability, compensating for other drivers' errors, is evaluated as separate skills. Moreover, one item, "*Adjusting your speed to the conditions*", loaded into safety skills in Sweden and cross-loaded into two dimensions in Turkey. Similarly, the item showed factorial inconsistency in previous studies (Lajunen & Summala, 1995; Öztürk, 2017; Wallén Warner et al., 2013). Following appropriate speed was seen as safety skills in Sweden while evaluated as either perceptual-motor skills or safety skills in Turkey. In Turkey, the item may be interpreted as "being technically able to adjust the speed" or "adjusting speed for safety preferences”, resulting in a cross-loading. Finally, one item in Sweden, “*Relinquishing” legitimate rights when necessary*”, did not load into any of two factors while loading into safety skills in Turkey. In a different study, the last two items were also found to be showing inconsistent factorial loadings across different countries (Wallén Warner et al., 2013). It could therefore be suggested that these two items (*Adjusting your speed to the conditions* and *Relinquishing legitimate rights when necessary*) could be re-evaluated or removed from the scale in future studies.

Overall, it could be discussed that the factorial structures of the measurements showed appropriate item distribution and content for the related variables. Moreover, despite not showing full identity for each dimension, the three measurements showed factorial similarity between Turkey and Sweden (over a value of .84 for Tucker’s phi). Besides, full factorial identity was achieved for functionality, internal requirements and fate dimensions (over .95). Only one dimension, own behaviours, showed nonnegligible incongruity. In light of this, it could be essential to re-examine the item content and the psychometric properties of the Multidimensional Traffic Locus of Control Scale.

4.2.2. Descriptive and Correlation Analyses

In terms of the drivers’ automation preferences, compared to general positive attitudes toward automated vehicles (Liljamo et al., 2018; Schoettle & Sivak, 2014), in Turkey, the most preferred level of vehicle automation was level 2, partial automation, while the least preferred option was the highly automated vehicles, level 4. On the other hand, in Sweden, the most preferred option was level 0, vehicles without automation technology, whereas the least preferred option was the highly automated vehicles, level 4. The most preferred options were found to be the ones already available to the public in two countries. Similarly, Rodrigues et al. (2021) also found that the majority of the drivers from Portuguese preferred to buy publicly available vehicles compared to the vehicles with automated driving systems. Similarly, Bıçaksız et al. (2019) also found that, in Turkey, the majority of the participants would accept vehicles with lower levels of automation. This situation could also be related to the drivers’ awareness and experiences with the proposed options. For instance, Cunningham et al. (2019) found that familiarity with the adaptive cruise control technology was associated with willingness to pay for an automated vehicle. In similar logic, the majority of the drivers preferred to driver one of the first three levels of vehicle technologies which are the current, publicly available technologies and therefore familiar.

Similar to the findings of Bıçaksız et al. (2019), highly automated vehicles were the least preferred option in both Turkey and Sweden. That could be due to the uncertainty created by the takeover situation. Moreover, it has been discussed that disengagement of the automated vehicle system could be because of various situations such as poor infrastructure or construction zone (Boggs et al., 2020). Besides, Merat et al. (2014) found that drivers' driving and take over performance was better when the control of the vehicle was in fixed based, predictable situations. Drivers required around 40 s to control the vehicle successfully. As highlighted by Boggs et al. (2020), a certain educational program is needed to teach responding safely, quickly and successfully to the takeover request of the vehicle. Training programs for highly automated vehicles could play a crucial role in that low level of preference. In another study, Liljamo et al. (2018) found that the majority of the participants (92%) would like to control automated function. Besides, participants reported that they would feel stressed when the control of the vehicle was given to a computer. With the increased level of automation, human driver gradually losses control of the vehicle. This demand and desire to keep control of the vehicle and driving may be one of the reasons behind this higher percentage of preferring vehicles with lower levels of automation. Moreover, drivers who actually enjoy driving may also prefer to keep control of the vehicle. Similarly, if drivers are satisfied with their vehicles and the technologies that vehicles present, they may continue to prefer similar levels of automation.

A few correlation coefficients should be mentioned in terms of the similarities and differences between Turkey and Sweden. Similar to the findings of Hartwich et al. (2019) and Liljamo et al. (2018) in terms of age and automated vehicle preferences, demographic variables including age, license year and the number of active and passive accidents were not correlated with the automated vehicle preference. Similarly, Zhang et al. (2020) also found behavioural intention to use level 3 automated vehicles was not correlated with age, experience and accident history. On the other hand, similar to findings of Syahrivar et al. (2021), in Turkey, drivers with higher experience in terms of last year kilometres preferred vehicles with lower levels of automation.

Besides, similar to the positive associations between age and driving skills (Ostapczuk et al., 2017), age was only positively correlated with safety skills in Turkey and perceptual-motor skills in Sweden. Supporting the findings of Chu et al. (2019), functionality was negatively correlated with age in Sweden and license year in Turkey and Sweden. Finally, in terms of the association between traffic climate and traffic locus of control, external affective demands were positively correlated with all factors of T-LoC in Turkey and fate and other drivers in Sweden.

4.2.3. Gender and Cross-Country Differences

As presented in the results section, country and gender differences among automation preference, traffic climate, traffic locus of control and driving skills were tested. The results revealed significant country and within- and between-country gender differences among variables.

4.2.3.1. Gender Differences

In the present study, male drivers preferred vehicles with higher levels of automation than female drivers. Similarly, Liljamo et al. (2018) and Payre et al. (2014) reported that males had more positive attitudes and a higher tendency to buy and use fully automated vehicles than females. Hohenberger et al. (2016) also found that males were more willing to use automated vehicles than females. In another study, Ward et al. (2017) reported that males had higher perceived benefit regarding self-driving vehicles than women. There could be various reasons for this difference. First of all, Hohenberger et al. (2016) found that males and females associated different emotions towards automated vehicles. Notably, for females, the association between anxiety and automated vehicles was stronger than the association between pleasure and automated vehicles.

On the other hand, males strongly associated automated vehicles with pleasure than anxiety. Concerning that, higher levels of automation could mean increased anxiety and decreased pleasure for females and increased pleasure and fun and decreased anxiety for males (Hohenberger et al., 2016). Similarly, Schoettle and Sivak (2014) also found that, regarding connected vehicle technology, females had more significant concerns regarding using these vehicles than males. Females in the present study may be experiencing similar concerns with the different higher levels of automation. Because of more noteworthy concerns and doubts about the potential benefits, they may prefer vehicles with lower levels of automation.

In terms of the traffic climate dimensions, the only significant gender difference was found for the internal requirements dimension. Like the drivers from China (Üzümcüoğlu Zihni, 2018), female drivers from Turkey and Sweden perceived traffic systems more internally demanding than male drivers from the same countries. It could be discussed that substantial gender difference in internal requirements but not in external affective demands and functionality could indicate two crucial points. First, Gehlert et al. (2014) discussed that factors of the traffic climate focused on perceived emotional demands and functional characteristics of the traffic system and cognitive abilities to master the traffic system. In other words, external affective demands and functionality dimensions focus on the perceived characteristics of the traffic system. On the other hand, internal requirements were not only the perceived characteristics of the traffic system but also the perceived expectations of the traffic system in terms of skills and abilities from drivers to participate in the traffic system. In this sense, not significant gender differences in terms of external affective demands or functionality may be interpreted as drivers perceive these characteristics of the traffic system similarly regardless of their gender difference. However, a significant gender difference in internal requirements might mean that female and male drivers perceive the traffic system's skill and ability expectations differently. Female drivers in Turkey, Sweden and the total sample perceived the traffic system as more internally demanding than male drivers. From the opposite side of that discussion, in another study, Pravossoudovitch et al. (2015) found that, compared to males, females reported female drivers as more skilful whereas, compared to females, males perceived male drivers more skilful. Moreover, several studies have also found gender differences in self-reported driving skills (Özkan & Lajunen, 2006; Öztürk et al., 2019; Xu et al., 2018b). In addition to these, safety skills were positively correlated with internal requirements in both countries. Contrary to nonsignificant correlations in the present study, in another study, Güner et al. (2018) found perceptual-motor skills positively correlated with internal requirements. Overall, the differences in perceived own and other drivers' driving skills may also be related to the differences in internal requirements.

For dimensions of traffic locus of control, female drivers had stronger vehicle and environment attribution than male drivers in Turkey. On the other hand, in Sweden, female drivers had higher vehicle and environment, fate, and other drivers. Similarly, in the total sample, females had stronger vehicle and environment, fate and other drivers attribution than male drivers. Similarly, Özkan and Lajunen (2005) also found that other drivers and vehicle and environment were positively associated with females. In addition to that, Sun et al. (2020) also found that, contrary to male drivers, female drivers had stronger external attribution factors of other drivers, vehicle/environment and fate. In general, it may be suggested female drivers had a stronger external traffic locus of control than male drivers.

In addition to that, regarding self-evaluation of driving skills, perceptual-motor skills showed significant differences in Turkey and Sweden, while safety skills showed significant differences only in Sweden. Besides, significant differences were determined for both dimensions in the total sample. As stated earlier, there have been some controversial findings regarding gender differences in terms of perceptual-motor skills. Similar to the findings of Özkan and Lajunen (2006) and Xu et al. (2018b), regardless of the country, male drivers reported significantly stronger perceptual-motor skills than female drivers. On the other hand, unlike Turkey, female drivers in Sweden reported stronger safety skills than male drivers. The difference was also significant for the whole sample, indicating female drivers had stronger safety skills than male drivers. The findings supported the previous studies indicating stronger safety skills for female drivers than male drivers (Özkan & Lajunen, 2006; Xu et al., 2018b). In another study, Öztürk et al. (2019) also found a similar nonsignificant difference in terms of safety skills in Turkey. Overall, together with the internal requirements and perceptual-motor skills, male drivers appeared to be more confident in their perceptual-motor skills and did perceive the traffic system's demands less than female drivers.

4.2.3.2. Country Differences

In addition to gender differences, some country-level differences were observed between Turkey and Sweden. Supporting the findings of previous studies (Kaye et al., 2020; Schoettle & Sivak, 2014; Syahrivar et al., 2021), automation preferences of drivers differed across countries. In the present study, drivers from Turkey preferred higher levels of automation than drivers from Sweden. Many factors, some of which are discussed in the following sections, may cause this difference, such as perceptual-motor skills.

The most significant country differences were found for the dimensions of traffic climate. Gehlert et al. (2014) discussed that a safe traffic system would be less emotionally demanding and more functional. Similarly, with respect to the traffic climate of Turkey and Sweden, Turkey was evaluated as having higher scores on external affective demands and internal requirements and lower scores on functionality. In other words, Turkey's traffic system was seen as more demanding in terms of both emotions and skills, whereas Sweden's traffic system was more of a less demanding and more functional traffic system. Based on the differences between the two countries' traffic climate, it could be suggested that Sweden having a safer and less risky traffic system than Turkey. This suggestion was also supported by the number of traffic fatalities (estimated 12.3 for Turkey and 2.8 for Sweden per 100000 population) in both countries (WHO, 2018) and the conclusion of the report of ETSC (2020), stating Sweden is one of the safest countries for road users. Besides, according to the Global Competitiveness Report (World Economic Forum, 2019), Sweden is the 20th country with a value of 5.3 in quality of road infrastructure and the 8th country with a value of 95.9 in road connectivity. Contrary to these, Turkey is the 31st country with a value of 5.0 in the quality of road infrastructure and the 34th country with a value of 87.1 in road connectivity. From that point of view, it would also be possible to conclude that road users' perception of the traffic system was also consistent with the objectively measured numbers and expert evaluations of the current traffic system.

Similar to the country differences in traffic climate, country-based differences were also observed for dimensions of traffic locus of control. Drivers from Turkey reported higher vehicle and environment, own skills, other drivers and own behaviours, whereas drivers from Sweden showed more fate. One of the possible explanations of higher attribution to different factors in Turkey compared to Sweden could be related to the overall accident exposure of drivers. As seen in the current sample and road safety statistics (WHO, 2018), drivers in Turkey experienced a significantly higher number of accidents than drivers from Sweden. From that point of view, the high exposure to accidents could also be associated with the traffic locus of control regardless of being internal or external. On the other hand, it was especially surprising to find higher fate attribution in Sweden compared to Turkey, considering that fate related practices such as hanging amulets and religious texts against bad luck were very common in Turkey (Özkan & Lajunen, 2005). It should also be highlighted that though fate in Sweden included one item (dangerous roads) more than fate in Turkey, full factorial identity was achieved between the factors. Besides, item-based comparisons showed that Turkey scored higher on dangerous roads than Sweden. In addition to that, considering the infrastructure quality of the roads mentioned above, it could be suggested that the difference was not related to item difference but related to general attribution difference between Turkey and Sweden. Besides, it should also be highlighted that even though Sweden had higher fate scores than Turkey, it is still the fourth factor in terms of frequency out of five factors in Sweden. Fate scores were especially low in Turkey compared to other factors. This difference might also be caused because of the higher attribution of accidents to other factors other than fate in Turkey. Özkan and Lajunen (2005) also found that fate had smaller values than other dimensions.

For driving skills, a significant country difference was found for safety skills, while the difference was not significant for perceptual-motor skills. Drivers from Turkey reported higher safety skills than drivers from Sweden. The findings of the present study supported the comparisons between drivers from Turkey and Sweden ten years ago. Similarly, Wallén Warner et al. (2010) also found that drivers from Turkey revealed higher safety skills than drivers from Sweden, whereas the difference for perceptual-motor skills was not statistically significant. It could be suggested that drivers in Turkey perceived themselves as having higher levels of safety skills than drivers in Sweden. This difference could also be seen because of the variations seen due to the age and exposure characteristics of the samples. Martinussen et al. (2017) found discrepancies between driving performance and self-reported driving skills of young male drivers, especially less skilled drivers. In the present study, the sample from Turkey was relatively young, and one-third of the participants were males.

4.2.3.3. Gender and Country Interactions

Finally, in addition to the significant gender and country differences, the interaction effects were only found for fate and other drivers dimensions of traffic locus of control. For the fate dimension of both female and male drivers, drivers in Sweden had higher fate attribution than drivers in Turkey. On the other hand, unlike the nonsignificant gender difference in Turkey, female drivers in Sweden had higher fate values than male drivers in Sweden. Overall, it could be concluded that, in terms of fate attributions, drivers, especially female drivers, from Sweden had stronger fate attribution than other groups. The interactions supporting the previous findings with Turkish drivers (Özkan & Lajunen, 2005) indicated a nonsignificant relationship between gender and fate in Turkey. However, supporting the difference in the sample from Sweden, Măirean et al. (2017) also found female Romanian drivers had higher fate attribution than male drivers.

In terms of other drivers dimension of traffic locus of control, contrary to female drivers in the two countries, there was a significant difference for male drivers indicating male drivers in Turkey had higher other drivers scores than male drivers in Sweden. Moreover, unlike nonsignificant gender difference in Turkey, female drivers in Sweden had stronger other drivers attribution than male drivers in Sweden. In another study (Özkan & Lajunen, 2005), being female was positively correlated with other drivers.

4.2.4. Factors Related to Drivers' Automated Vehicle Preferences

In line with the aims of the present thesis, the roles of traffic climate, traffic locus of control and driving skills with the preferred level of vehicle automation were examined with hierarchical regression and moderated moderation analyses. With the hierarchical regression analyses, the direct effects of the factors of traffic climate, traffic locus of control and driving skills were studied. In the final moderated moderation model (see Figure 1.), three-way interaction effects of traffic locus of control and driving skills with the traffic climate on two countries were investigated. While significant direct associations were found for functionality, own skills, other drivers, perceptual-motor skills and safety skills, the strongest associations were between driving skills and automation preferences. In addition to the direct relations, significant three-way interactions based on the final model were discussed in this section.

In terms of factors of traffic climate, it was expected that external affective demands and internal requirements would be positively associated with a preference toward higher levels of automation, and functionality will not be related to automation preference in a specific direction. Contrary to our expectations, internal requirements were not related to automation preferences either directly or indirectly. This could be explained by the age of the samples. As discussed by Üzümcüoğlu Zihni (2018), development of attitudes toward traffic climate may require a certain amount of experience with the traffic system. Similar to the discussion on the factorial structure of TCS, since the sample from Turkey was relatively younger, drivers may need more exposure in order to have stable traffic climate perception toward the traffic system.

On the other hand, external affective demands and functionality showed significant moderator roles by interacting with the country, which will be discussed later in the text. Only one significant direct association was found between functionality and automated vehicle preferences in Turkey. It was found that functionality was positively associated with automation preferences. Drivers who perceive the traffic system as high in functionality also preferred higher levels of automation. Functionality is related to the characteristics and requirements of a functional system (Chu et al., 2019; Gehlert et al., 2014). Drivers who perceive the traffic system as highly functional may be preferring higher levels of automation considering the potential technological components and functions of automated vehicles.

In contrast to the expectations, factors of traffic locus of control mainly were not related to automated driving preferences. None of the dimensions was associated with automated driving preferences in Turkey. Our expectations regarding the direct effects of traffic locus of control were partially supported in Sweden. The significant associations were between own skills and other drivers with the automation preferences in Sweden. As expected, the association between own skills and automated preferences indicated that drivers who attribute road traffic accidents to their own skills preferred higher automation levels. Similarly, Payre et al. (2014) also found internal locus of control was positively correlated with the intention to buy and acceptability of fully automated vehicles. In the study of Hagl and Kouabenan (2020), drivers using advanced driver-assistance systems showed a decreased probability of involving in accidents because of risky driver behaviours. In a similar sense, it could be suggested that, either because of increased functions of automated systems or decreased roles of human drivers while driving, drivers with higher own skills attribution may prefer higher levels of automation. In that sense, automated systems could play a protective role against accidents due to human errors.

Contrary to the previous finding of Syahrivar et al. (2021), indicating a positive association between external driver locus of control and attitudes toward automated vehicles, in line with the expectations, drivers who attribute accidents to other drivers preferred lower levels of automation. Attribution to other drivers means that drivers perceive the reasons for accidents as the behaviours and skills of other drivers. With respect to that, drivers with higher other drivers attribution may prefer to have control of their vehicles. For instance, Liljamo et al. (2018) found that around 70% of the participants would feel stressed when the control of the driving was given to a computer. As the level of automation increases, drivers give control of certain tasks and even whole driving to the automated system. In that case, similar to the negative association with perceptual-motor skills, drivers may want to have control of the vehicle to be able to avoid accidents occurring due to other drivers' driving skills and behaviours. Even though Bıçaksız et al. (2019) reported a positive association between fate and accepted level of automation, in line with the expectations of the present study, fate was not related to automated preferences either in Turkey or Sweden.

Considering the relationship between driving skills and drivers' automation preferences, the majority of the findings supported the expectations of the present study. Two essential findings come to the forefront. First of all, perceptual-motor skills were significantly related to drivers' automation preferences both in Turkey and Sweden. The relationship states that drivers with higher levels of perceptual-motor skills prefer lower levels of automated vehicles. It is believed that the effect might be associated with the components of perceptual-motor skills. As defined by Lajunen and Summala (1995), perceptual-motor skills cover technical skills related to driving, such as controlling the vehicle. Based on the results, it could be discussed that drivers who perceive themselves as skilful in terms of technical skills of driving may not prefer higher levels of automation because of different reasons. First of all, drivers may have negative attitudes toward in-vehicle technologies and resist using these in-vehicle technologies that result in the loss of control over driving (Özkan et al., 2005). It could be generally discussed that the higher the level of automation, the less technical skills the drivers will likely be using in the traffic while driving and less control over different functions of driving. In other words, as the level of automation increases, drivers may no longer be able to use or need these existing technical skills. Therefore, drivers who were overconfident of their skills may prefer lower-level vehicles, considering these as advantages. At the same time, drivers may prefer this as there are possibilities of using different skills in vehicles with lower levels of automation.

When the relationship is considered by looking from the opposite side, the results indicate that drivers with lower perceptual-motor skills also prefer higher automation levels. It could be discussed that driving vehicles with higher levels of automation also means that drivers will be able to transfer some technical tasks (Navarro, 2019). These tasks were closely related to perceptual-motor skills to operate the vehicle. This transfer of skills can ease the burden of driving duties on drivers. In other words, if the drivers see themselves lacking in some technical skills, higher levels of automation can be seen as a compensation mechanism for these shortcomings. Similarly, in Sweden, it was also found that drivers who attribute road traffic accidents to their own skills also preferred higher levels of automation. The perceived lack of technical skills and accident causation due to their own skills may result in preference toward vehicles with higher levels of automation. Similarly, automated vehicles could play a compensatory role for their perceived lack of skills.

Contrary to the associations between perceptual-motor skills, safety skills only showed significant relations in Turkey. According to this relation, drivers who perceive their safety skills high also preferred higher levels of automated vehicles. In addition to that, the three-way interaction between safety skills-external affective demands-country was also significant. In Sweden, safety skills were positively associated with a higher preference toward higher levels of automation only in high external affective demands. The proposed safety benefits of automated vehicles could be playing a crucial role in these relationships. Even though the relationship is clearer in Turkey, in general, it could be highlighted that drivers with higher safety skills might be focusing on the safety aspects of automated vehicles and prefer more elevated levels of automation. For instance, Hagl and Kouabenan (2020) found that drivers using advanced driver-assistance systems had higher risk controllability perception and lower perception of being involved in an accident due to risk behaviours. In other words, automated systems might be increasing the safety perception of the drivers. In another study, Özkan et al. (2005) discussed that safety skills positively associated with all types of intelligent speed adaptation systems. Safety concerns were also seen as a crucial factor for in-vehicle technologies.

Besides, our expectations indicating a positive association between safety skills and a preference toward higher levels of automation in Sweden were partially supported. It is crucial that the relationship is only significant in Sweden when external affective demands were high. In other words, safety skills were only positively associated with the preference toward higher levels of automation when the traffic system is perceived to be highly emotionally demanding. This high level of external affective demands may be activating the positive association between safety skills and higher levels of automation. Gehlert et al. (2014) stated that external affective demands were mainly related to other's driving style. Moreover, Üzümcüoğlu et al. (2019) also highlighted the additional cognitive load caused by high external affective demands and approached external affective demands as an additional secondary task for driving. Based on that, it could be suggested that, in Sweden, when drivers perceive the other drivers' driving style as demanding and risky, higher safety skills also associated with a higher preference toward higher levels of automation. Moreover, drivers with higher safety skills may prefer vehicles with higher levels of automation to be able to cope with the additional cognitive load that high external affective demands caused. Besides, as highlighted earlier, safety skills were not directly associated with the automation preferences in Sweden. This could be related to safety concerns associated with higher levels of automation. Noy et al. (2018) discussed some of the potential technical and technological failures that could cause new forms of accidents resulting from automation. Moreover, Liljamo et al. (2018) found that technical unreliability was one of the top three concerns. However, it appears that higher levels of external affective demands changed this relationship. Qu et al. (2019) found that concerns with the autonomous system were less likely to be seen for drivers perceiving the current traffic system as low in terms of external affective demands. In that sense, the effect of safety skills might be activated when the external factors were challenging. In a driving environment perceived to be riskier, drivers with higher safety skills may need additional support to achieve safe driving.

On the other hand, in Turkey, safety skills were positively associated with a preference toward higher levels of automation under low or moderate level of external affective demands. As discussed earlier, the results supported the expected relations between safety skills and automated vehicle preferences in general. However, it was surprising to find that the positive association was lost when the traffic system was perceived to be externally demanding. Qu et al. (2019) found a positive association between external affective demands and concerns toward automated systems. In Turkey, the concerns due to a higher level of external affective demands may play a role by negatively affecting the relations of safety skills with the preferred level of vehicle automation.

Contrary to our expectations focusing on a negative relationship between vehicle and environment factor and preference toward higher levels of automation, the three-way interaction effect between vehicle and environment-external affective demands-country revealed that the vehicle and environment factor showed a positive association with the preference toward higher levels of automation under the moderating effects of external affective demands and country. Similar to the interaction between safety skills and external affective demands, the interaction effects showed that, in Sweden, vehicle and environment attribution was positively associated with a preference toward higher levels of automation when the traffic system is perceived to be highly emotionally demanding. Similarly, Syahrivar et al. (2021) found a positive association between external locus of control and attitudes toward automated vehicles. Özkan et al. (2005) also found that vehicle and environment were positively related to attitudes toward in-vehicle technologies. This could be associated with the characteristics of drivers with higher vehicle and environment. Özkan and Lajunen (2005) discussed that the traffic system might be perceived as risky and demanding by the drivers with higher vehicle and environment or external traffic locus of control. Moreover, drivers with a higher external locus of control might perceive the traffic system as something to cope with (Özkan and Lajunen, 2005). Similarly, with the elevated external affective demands, drivers perceive other drivers' driver behaviours as riskier (Gehlert et al., 2014).

Overall, it could be suggested that, under the emotionally demanding driving environment, drivers who attribute accidents to the vehicle and environment factors tend to prefer higher levels of automation. That demanding traffic environment may play a triggering role to prefer vehicles with more functions. In that sense, drivers who perceive the traffic system as externally demanding and have a tendency to attribute accidents to the vehicle and environment factors may be believing that current vehicle technologies were the main reasons for accidents and needed to be improved. For that reason, vehicles and roads will be safer with automated vehicles, and automated vehicles could increase the overall control in the driving system. Increased levels of automation could decrease the demands coming from the traffic environment and solve the problems associated with the vehicle and environment causing accidents. Interestingly, in a recent study conducted by Franklin et al. (2021), under complex and novel situations, road users had a tendency to blame the automated vehicle system more than human drivers. If it is assumed that complex situations were related to higher external affective demands, drivers may continue to attribute negative outcomes to vehicle and environment factors by blaming the automated vehicles.

Additionally, there were significant three-way interactions of own skill-functionality-country and other drivers-functionality-country. For own skills, a positive association between own skills and automation preferences was found for low and moderate levels of functionality in Sweden. In other words, for drivers who perceive the traffic system as low or moderate in terms of functionality, higher attribution of road traffic accidents to self positively associated with a preference toward higher levels of automation. On the contrary, a negative association between other drivers and automation preferences was found for a high level of functionality in Sweden. Attribution to other drivers was negatively associated with a preference toward higher levels of automation when the traffic system perceived to be highly functional. In the study of Qu et al. (2019), functionality was positively correlated with willingness to use autonomous vehicles whereas, at the same time, positively predicted people's concerns about the autopilot mode. Based on that, it could be discussed that after a certain point of functionality, concerns about automated vehicles could neutralise the association between own skills and automated vehicle preferences. Additionally, especially for drivers who attribute the accidents to other drivers, higher functionality might highlight the concerns associated. In other words, when the current traffic system was perceived to be highly functional, drivers who were more concerned about the behaviours of other drivers may want to have more control over driving and preferred vehicles with lower levels of automation.

4.3. Limitations

A few limitations of the study are needed to be considered while interpreting the results and designing future studies. First of all, even though the findings of the present study revealed great country and gender differences in terms of both independent variables and automated preferences and significant associations with respect to automated vehicles, the final interaction models explained a relatively small amount of variance. In that sense, the findings of the present study should be interpreted considering this.

In line with the purpose of the present study, the dependent variable was measured with a single item question. However, different studies (Buckley et al., 2018; Cunningham et al., 2019; Qu et al., 2019) had measured various aspects of automated driving, such as perceived usefulness, benefits, concerns. The findings of the present study, in a general sense, associated traffic climate, traffic locus of control and driving skills with drivers' automated vehicle preference, but the findings were limited in a general preference of automated vehicles.

Another important limitation of the study is that the samples of both countries consisted of university students. Therefore, the samples were not representative of the drivers in Turkey or Sweden. Additionally, the differences between Turkey and Sweden could also be affected by the demographic characteristics of the two samples. As mentioned earlier, drivers from Turkey had more active and passive accidents than drivers from Sweden. On the contrary, they were also younger and had less driving experience. Additionally, the relatively inexperienced group of drivers may also play a role in interpreting the traffic system of a country. As mentioned earlier, Üzümcüoğlu Zihni (2018) discussed that experience could be an essential pre-requisite to develop reliable traffic climate attitudes.

Overall, it could be suggested that drivers from Sweden were relatively more experienced and safer (in terms of accident history). It would be important to consider the characteristics of the samples while focusing on these similarities and differences in correlation coefficients between countries and further analyses. However, to overcome this limitation, age and last year kilometres were entered as control variables in each analysis.

The final limitation of the current study is that all the measurements were self-report instruments. As discussed by af Wåhlberg et al. (2011; 2015), there might be several issues such as common method variance, publication bias and socially desirable responding in using self-reports and self-report studies. To overcome socially desirable responding, participants' anonymity was assured. In addition, some of the participants in Turkey received bonus points for their participation in the study compared to participants from Sweden. That situation may have resulted in some motivational differences between participants.

4.4. Implications

In the following section, the implications of the findings of the present study will be discussed. First of all, the present study is the first study to examine how traffic climate, traffic locus of control and driving skills related to drivers' vehicle preferences. Additionally, the final model tested revealed some further findings for the factors relating to the preferred level of vehicle automation. First of all, even though dimensions of traffic climate did not show direct relations with the preferred level of vehicle automation, except for functionality in Turkey, the three-way interaction effects of external affective demands-functionality and country with traffic locus of control/driving skills in the final model showed different patterns. One of the notable highlights is that, while driving skills were related to automation preferences in regression analyses, most of the significant interaction effects were found between dimensions of the traffic locus of control and traffic climate in Sweden. Among the traffic climate dimensions, considerable moderation effects were only found for external factors as functionality and external affective demands. Contrary to Qu et al. (2019), suggesting a positive association between internal requirements and willingness to use autonomous vehicles, internal requirements were not associated with automated vehicle preferences. It could be recommended that, contrary to the lack of direct effects of traffic climate dimensions in Turkey and Sweden, traffic climate could be playing an indirect role in drivers' vehicle preference.

Additionally, the findings supported the previously tested moderator role of the country (Üzümcüoğlu et al., 2020a). Considering the country differences with respect to different variables and secondary moderator role in the final model, significant country differences were observed in the three-way interactions. The majority of the interactions were significant in Sweden, where, in general, the traffic system is perceived to be safer. With respect to the interactions of traffic climate and country with traffic locus of control and driving skills, it could be suggested that drivers' vehicle automation preferences are not only affected by the individual-level variables (traffic locus of control and driving skills) but also macro-level variables (country differences and traffic climate).

In general, the results of the present study supported previous studies identifying cross country differences in automated vehicles (Kaye et al., 2020; Schoettle & Sivak, 2014), traffic climate (Üzümcüoğlu Zihni, 2018), and driving skills (Wallén Warner et al., 2013). Similar to the road safety statistics of Turkey and Sweden (WHO, 2018), samples from the two countries showed crucial differences in various measurements related to different aspects of driving. Especially considering the success of Sweden's road safety policies (WHO, 2018), it would be essential to take into account the possible country differences while adapting the best practices in Turkey.

Noy et al. (2018) highlighted that the inclusion of more vehicles with higher levels of automation in the traffic system might cause radical definition changes in many traffic-related variables. Although the majority of the relations between the traffic climate and automated vehicle preferences were not significant in the present study, it is thought that following the inclusion of vehicles with different levels of automation, in theory, may provide important findings, especially for traffic safety and traffic climate studies. When the relations between traffic climate and automated vehicle examined, significant changes are expected in the general traffic system. Accordingly, changes are also expected in the perception of traffic climate with the inclusion of different levels of automated vehicles in the traffic system. For instance, automated vehicles may have particular advantages for elderly road users and road users with mobility impairments (Alessandrini et al., 2015). That might increase the number of private vehicles. On the contrary, Stoiber et al. (2019) also compared the use of different full automated vehicles (private, pooled-use and auto-shuttles). It was found that 61% of the participants preferred pooled use or shuttles over private fully automated vehicles (Stoiber et al., 2019). Therefore, with the possibility of "ordering" automated vehicle to anywhere you are, road users might prefer more pooled vehicles as a new mode of transportation. Depending on the implementation of automated vehicles to the traffic system, automation might increase or decrease the number of vehicles (Galich & Stark, 2021). Either way, in a dynamic multilevel, multicomponent traffic system proposed by Özkan and Lajunen (2011; 2015), the automated vehicles might have a gradual but substantial impact on a country's traffic system and eventually on the traffic climate.

As discussed by Chan (2017), with the automated driving systems, a more efficient, effective and less demanding traffic environment was expected. Similarly, Noy et al. (2018) also discussed the potential benefits of automated driving. For instance, even with the introduction of driver-assistance systems which is a low level of automation, driving was expected to be more comfortable and safer (Hagl & Kouabenan, 2020).

Based on the discussion of Gehlert et al. (2014) on the relations of traffic climate and safety of road users, it could be suggested that automated driving systems may result in a traffic environment that is stronger and safer for all road users. It could be discussed that, based on these expectations, when the automated vehicles with higher levels of automation become part of the future traffic system, the traffic environment would be more functional and less externally demanding for drivers. As a result, that might increase the overall safety of road users. However, Noy et al. (2018) also highlighted that, with the introduction of algorithms and software to the traffic system, road environment and the perception of road users might become more complex. In another study conducted by Liu et al. (2020), a greater intention to show aggressive behaviours toward automated drivers compared to human drivers was reported by drivers, especially by males, from China and South Korea. Similarly, May et al. (2020) also discussed that automated vehicles on urban roads could increase individual travels and decrease public transportation, walking and cycling. Besides, in another study (Liljamo et al., 2018), a possible increase in traffic density was reported. Overall, these impacts of automated vehicles might increase demands on the traffic system. In this case, expectations for decreased external affective demands may not be achieved.

Saffarian et al. (2012) discussed that skill degradation was one of the challenges associated with automation. In addition to that, Navarro (2019) showed a gradual decrease in driving skills needed to operate with the increased level of automation from manual driving to fully automated driving. With these changes, the skills and abilities required to operate the vehicle and within the traffic system may change over time and with different levels of automation (Merriman et al., 2021; Navarro, 2019). The changes in skills may also result in shifts in the perception of internal requirements in the traffic system. Based on that change and the dominant form of vehicles in the traffic system, road users' perception of internal requirements may change.

Along with the internal requirements, one of the most crucial findings of the present study is related to the association between driving skills and autonomous preference. As discussed in more details in the previous sections, issues such as how high-level automated vehicles were perceived by drivers in terms of skills and what inferences do they make when they asked to evaluate these vehicles considering their own skills are important for further examination of these relationships. At the same time, considering the skills needed to operate vehicles with different levels of automation changes (Navarro, 2019), it would be essential to review the item content of the DSI for different automation levels when the different technical requirements coming from the vehicle used and the traffic system were in question. For instance, “successfully take over and stabilise the vehicle” and “continuing to monitor the environment for potential risks while the system has the control of the vehicle” could be essential skills for vehicles after a certain level of automation.

Apart from the associations mentioned above, Merriman et al. (2021) also highlighted the significance of driving skills and training at different levels of automation. Eight facets of manual driver training (i.e. workload, speed of processing, attitudes and personality, situation awareness, attention and memory, procedural skills, hazard and risk perception, mental models) and trust were determined as key elements in driving training for future automated systems. It was also discussed that, except for the fully automated vehicles, each level of automation would need human drivers as either necessarily or optionally. That means drivers’ skills will still be part of the driving process. Besides, drivers will also need to understand and comprehend the capabilities and limitations of the automated systems and adapt their behaviours accordingly (Merriman et al., 2021). Considering the importance of perceptual-motor skills and safety skills in automation preferences and the possible impacts of automated driving on different dimensions of driving skills, the development and implementation of training programs regarding covering the needs of available vehicle types would be necessary for road safety.

In addition to that, public education campaign could be used to promote positive attitudes toward automated vehicles (Kaye et al., 2020). Similar to the discussion on promoting positive emotions and reducing negative emotions while promoting automated vehicles (Hohenberger et al., 2016), the findings also provide important suggestions for activities such as marketing and advertising related to automated vehicles and driving skills. For example, if the findings of driving skills are considered, messages emphasising that technical skills may not be needed while driving in advertisements about automated vehicles, in general, may have a negative impact on the drivers with higher levels of perceptual-motor skills. These kinds of messages may result in avoidance and negative attitudes toward automated vehicles. In contrast to this, a higher emphasis on potential contributions toward perceptual-motor skills and any form of safety may result in drivers' positive opinions. In other words, promoting the safety impacts of automated vehicles could increase drivers' preference toward higher levels.

One of the crucial differences of the present study is related to measuring the reactions of road users' toward automated vehicles. For example, while the majority of the road users had reported positive attitudes toward automated vehicles (Liljamo et al., 2018; Schoettle & Sivak, 2014) or accept in a vehicle (Bıçaksız et al., 2019), when it comes to "prefer to drive out of options", the majority of the participants preferred vehicles with lower or no level of automation. In the literature, various methods focusing on different sides of the relationship have been used. For instance, Cunningham et al. (2019) focus on road users' willingness to pay for automated vehicle technologies. On the other hand, in the present study, participants were asked to choose their most preferred level of automation. It could be discussed that the findings of the present study may reflect the condition in which road users have an equal chance of choosing from different types of vehicles. The results could be interpreted that if all forms of vehicles were available in the market, there might be a wide range of road users choosing vehicles with lower levels of automation.

Aside from the theoretical and practical implications for automated vehicles, one of the crucial findings of the present study is that, both in Turkey and Sweden, female drivers reported lower perceptual-motor skills and perceived the traffic system high in terms of internal requirements. Considering both internal requirements and perceptual-motor skills are related to skills and abilities that are associated with traffic system, while one is the requirements of a traffic system and the latter is the evaluation of drivers' own technical skills, the associations might indicate that female drivers were under high skill-oriented pressure while driving. It could be discussed that females perceived themselves as less technically skilful and evaluated the traffic system demanding more skills and abilities from them. Concerning this, it could also be discussed that these drivers may also experience distress and other adverse behavioural outcomes while driving because of being less skilled and/or feeling high demands. Moreover, it should also be acknowledged that female drivers, especially in Sweden, also attributed road traffic accidents to external factors. Within this context, the skills and abilities that are required to successfully and safely operate within the traffic system might also be caused by attributing accidents to outsider factors. Supporting this, internal requirements were positively correlated with vehicle and environment and other drivers in two countries.

Another important implication of the findings is about the traffic system and regulations that can be made to improve it in Turkey. Based on the road safety statistics (TUIK, 2018; WHO, 2018) and findings related to traffic climate of Turkey, it could be inferred that the traffic system in Turkey was dangerous for road users. The system makes emotional and skill-oriented demands on all drivers, especially female drivers. It was also evaluated as a less functional traffic system compared to Sweden. In this respect, it is particularly important that road safety researchers and policymakers should take these into consideration. It could be suggested that the traffic system of Turkey could be improved through necessary practices by increasing its resilience and functionality and also decreasing demands over drivers.

4.5. Suggestions for Future Research

The findings of the present study showed great differences between Turkey and Sweden in terms of the majority of the variables. From this point of view, examining the relationships between variables in other countries may provide information about both the reliability and validity of the findings and their generalisability. In this sense, it could be discussed that the associations between variables showed different patterns in Turkey and Sweden. It would be essential to examine these differences in more detail in future studies. It was especially interesting to find significant moderator roles of traffic climate for Sweden since the adverse driving environment was reported in Turkey. Examining this difference in future studies could provide a more detailed understanding of how traffic climate is related to micro-level, driver-related factors.

As discussed earlier, even though there were some crucial points of the present study, the variances explained by the total model were relatively low. It could be discussed that there is a need for improvement in the model. For instance, in future studies, different aspects of automated vehicles and familiarity with the system were affecting preferences could be studied. Even though the present study proposed a general overview of different variables and their relations with the automated vehicle preference, in future studies, drivers may also be asked to indicate why they choose that option and what were the reasons behind this to see a qualitative interpretation of the different automation levels.

Future studies could also be essential to examine how different aspects of automated vehicles are affected by variables of the present study and associated with drivers' preference. For instance, following the findings of the present study with respect to the associations between driving skills and automation preferences, a detailed examination might give more insight into the association between skills and different aspects of automated vehicles. Besides, even though drivers may prefer certain levels of automation, they may not be able to afford that option. For instance, Elvik (2020) discussed that automated vehicles could be too expensive when they first introduced to the public. Because of that, drivers may have to choose the affordable one. That might also be an important consideration for future research. In addition to affordability issue, current vehicles that participants drive may also play a role with respect to their preference. Drivers may be evaluating the features of the options by comparing the vehicle they have. In future studies, the preferred level of vehicle automation could be compared with the owned vehicle and the satisfaction of drivers with the automation level of their vehicle.

Finally, as discussed in the limitations of the study, the characteristics of the samples from Turkey and Sweden showed some important differences. With respect to that, future studies could also consider examining the proposed relations with relatively similar groups of drivers in terms of exposure or other factors. Besides, drivers with different age and experience levels could also be compared across other countries and genders.

4.6. Conclusion

Social sciences may play various roles in different aspects of automated vehicles, from safety to data (Cohen et al., 2020). Ashkrof et al. (2019) discussed that different factors such as travellers' demographic characteristics, attitudes and travel purpose had affected the adoption to automated vehicles. Similarly, in the present study, different driver-related variables and aspects of the traffic system were associated with drivers' automated vehicle choices. Overall, some significant findings could be highlighted about the samples from Turkey and Sweden.

1. Similar to road safety statistics (WHO, 2018), drivers from Turkey and Sweden showed substantial differences in the measurements related to road safety, including automated vehicle preferences.

2. The majority of drivers in both countries preferred vehicles with lower or no levels of automation.

3. Gender and country differences played a crucial role in terms of vehicle preferences. In a general sense, male drivers and drivers from Turkey had a higher tendency to prefer higher levels of automation than female drivers or drivers from Sweden.

4. Safety skills, own skills and functionality were positively, and perceptual-motor skills and other drivers were negatively related to automated vehicle preferences.

5. External affective demands and functionality of the traffic systems of a country could play a moderating role in relations to different individual factors and automated vehicle preferences.

6. Overall, it could be suggested that drivers are implicitly or explicitly affected by different factors such as their driving skills, possible factors of accidents, the perception of the current traffic environment, and decide on the vehicle they would like to drive.

7. The findings also offer some crucial points, especially for those working in the research and marketing of automated vehicles.

8. Different individual- and country-level factors could play important roles in the future use of automated vehicles.

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APPENDICES

A: APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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16 MART 2020

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç.Dr. Henriette Wallen WARNER ve Prof.Dr. Türker ÖZKAN

Danışmanlığını yaptığınız **İbrahim ÖZTÜRK'ün** **"Factors Affecting the Preferred Level of Automation"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **328 ODTU 2019** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Prof.Dr. Mine MISIRLISOY
Başkan

Prof. Dr. Tolga CAN
Üye

Doç.Dr. Pınar KAYGAN
Üye

Dr. Öğr. Üyesi Ali Emre TURGUT
Üye

Dr. Öğr. Üyesi Şerife SEVİNÇ
Üye

Dr. Öğr. Üyesi Müge GÜNDÜZ
Üye

Dr. Öğr. Üyesi Süreyya Özcan KABASAKAL
Üye

B: INFORMED CONSENT FORM

Merhaba,

Orta Doğu Teknik Üniversitesi (ODTÜ) ve İsveç Ulusal Karayolu ve Ulaşım Araştırma Enstitüsü (VTI), kişilerin otonom araçlar hakkındaki görüşleri üzerine bir çalışma yürütmektedir. Bulgular gelecekteki ulaşım sistemi için değerli bilgiler sağlayacaktır.

Üniversite öğrencisiyseniz ve Türkiye'de geçerli olan B tipi ehliyet sahibiyseniz aşağıdaki anketi doldurarak bize yardımcı olabilirsiniz (yaklaşık 20 dk.). Ankete aşağıdaki bağlantıya tıklayarak ulaşabilirsiniz. Ayrıca, anket bağlantısını diğer üniversite öğrencileriyle paylaşarak da çalışmamıza destek olabilirsiniz.

Katılımınız tamamen gönüllülük esasına dayanmaktadır, ancak otomasyon hakkındaki görüşlerinizi bizimle paylaşmak için birkaç dakikanızı ayırmanızı umuyoruz. Tüm cevaplarınız gizlilik ilkesine uygun saklanacak ve kimse ile paylaşılmayacaktır.

Çalışma hakkında herhangi bir sorunuz varsa, bizimle iletişime geçebilirsiniz:
Doktor Adayı Uzman Psikolog İbrahim Öztürk (ozturki@metu.edu.tr)
Doç. Dr. Henriette Wallén Warner (henriette.wallen.warner@vti.se)
Prof. Dr. Türker Özkan (ozturker@metu.edu.tr)

Çalışmanın Eylül 2020'de tamamlanması beklenmektedir. Uzman Psikolog İbrahim Öztürk (ozturki@metu.edu.tr) ile iletişime geçerek çalışma hakkında bilgi elde edebilirsiniz.

Anket Bağlantısı (köprü olarak)

C: DEMOGRAPHIC INFORMATION FORM

1. Ehliyetiniz var mı (B Tipi)?

☐ Evet ☐ Hayır

2. Üniversite öğrencisi misiniz? (B Tipi)?

☐ Evet ☐ Hayır

3. Hangi yıl doğdunuz? ________

4. Cinsiyet? ☐ Erkek ☐ Kadın ☐ Diğer ☐ Belirsiz

5. Ehliyetinizi (B Tipi) hangi yıl aldınız?: __________________

6. Son bir yılda kaç kilometre araç kullandınız? ____________________

7. Son **üç yılda** kaç kez araç kullanırken **aktif** olarak (sizin diğer yol kullanıcılarına veya herhangi bir nesneye çarptığınız durumlar) kaza yaptınız? _______

8. Son **üç yılda** kaç kez araç kullanırken **pasif** olarak (diğer yol kullanıcılarının size çarptığı durumlar) kaza geçirdiniz? _______

9. Aşağıda farklı seviyelerdeki otomasyon tanımları verilmiştir.
Bir sürücü olarak, bu seviyelerden hangisini tercih edersiniz?

❑ Sıfır Otomasyon (seviye 0): Sürücü tüm görevleri sürüş boyunca yerine getirir. Örneğin, çarpışmalar için geri görüş kamerası uyarı sağlar ancak tüm işlemi sürücünün yapması gerekir.

- ❑ Sürüş Asistanı (seviye 1): Sistemler, belirli koşullar altında direksiyon **veya** hızlanma / yavaşlama gibi alt sürüş görevlerini yerine getirir. Örneğin, sürücünün doğru şeritte kalmasına yardımcı olan şerit sabitleme sistemleri **veya** sürücünün öndeki araçla güvenli bir mesafeyi korumasını sağlayan uyarlanabilir hız sabitleyicisi. Sürücünün diğer tüm sürüş görevlerini yerine getirmesi, sistemleri sürekli izlemesi ve gerekirse **müdahale etmesi** beklenir.

- ❑ Kısmi Otomasyon (seviye 2): Sistemler, belirli koşullar altında direksiyon **ve** hızlanma / yavaşlama gibi alt sürüş görevlerini yerine getirir. Örneğin, sürücünün doğru şeritte kalmasına yardımcı olan şerit sabitleme sistemleri **ve** sürücünün öndeki araçla güvenli bir mesafeyi korumasını sağlayan uyarlanabilir hız sabitleyicisi. Sürücünün diğer tüm sürüş görevlerini yerine getirmesi, sistemleri sürekli izlemesi ve gerekirse **müdahale etmesi** beklenir.

- ❑ Koşullu Otomasyon (seviye 3): Sistemler, **sınırlı** koşullar altında sollama gibi tüm dinamik sürüş görevlerini yerine getirir. Örneğin, araç kuyruklarında aracı kullanan trafik sıkışıklığı sürücüsü. Sürücünün sistemleri sürekli olarak izlemesi ve gerekirse **müdahale etmesi** beklenir.

- ❑ Yüksek Otomasyon (seviye 4): Sistemler, **sınırlı** koşullar altında sollama gibi tüm dinamik sürüş görevlerini yerine getirir. Örneğin, sınırlı bir alanda süren yerel sürücüsüz taksiler. Sürücü müdahale etmek **zorunda değildir**.

- ❑ Tam Otomasyon (seviye 5): Sistemler tüm dinamik sürüş görevlerini **her koşulda** yerine getirir. Sürücü sadece varış noktasını sisteme girer, bunun dışında müdahale etmek **zorunda değildir**.

D: TRAFFIC CLIMATE SCALE

Ülkemizde trafik sistemi nasıldır?

Aşağıda, ülkemizdeki trafik sistemini, ortamını ve atmosferini tanımlamak için bazı kelimeler verilmiştir. Bu kelimelerin, ülkemizdeki trafik durumunu yansıtıp yansıtmadığı hakkındaki düşüncenizi size göre doğru olan seçeneği karalayarak belirtiniz. Her bir soru için cevap seçenekleri:

1 = Hiç tanımlamıyor, 2 = Tanımlamıyor, 3= Pek az tanımlıyor,
4= Biraz tanımlıyor, 5= Tanımlıyor, 6= Çok tanımlıyor

	1	2	3	4	5	6			1	2	3	4	5	6
1.Tehlikeli	O	O	O	O	O	O		23.Karşılıklı anlayışa dayalı	O	O	O	O	O	O
2.Dinamik	O	O	O	O	O	O		24.Planlı	O	O	O	O	O	O
3.Karmaşık	O	O	O	O	O	O		25.Üzerinizde baskı yapıcı	O	O	O	O	O	O
4.Saldırgan	O	O	O	O	O	O		26.Olanları telafi etmeye yönelik	O	O	O	O	O	O
5.Heyecan verici	O	O	O	O	O	O		27.Caydırıcı kurallar içeren	O	O	O	O	O	O
6.Hızlı	O	O	O	O	O	O		28. Riskli	O	O	O	O	O	O
7.Stresli	O	O	O	O	O	O		29. Kaotik	O	O	O	O	O	O
8.Monoton	O	O	O	O	O	O		30.Sabır gerektiren	O	O	O	O	O	O
9. Şansa bağlı	O	O	O	O	O	O		31.Tedirgin edici	O	O	O	O	O	O
10. Tetikte olmanızı gerektiren	O	O	O	O	O	O		32.Uyanık olmayı gerektiren	O	O	O	O	O	O
11. Kadere bağlı	O	O	O	O	O	O		33.Beceri gerektiren	O	O	O	O	O	O
12. Tedbirli olunmasını gerektiren	O	O	O	O	O	O		34.Ahenkli	O	O	O	O	O	O
13. Deneyim gerektiren	O	O	O	O	O	O		35.Zaman kaybettiren	O	O	O	O	O	O
14. Çabukluk gerektiren	O	O	O	O	O	O		36.Sinir bozucu	O	O	O	O	O	O
15. Trafik kurallarına uymanızı isteyen	O	O	O	O	O	O		37.Eşitlikçi	O	O	O	O	O	O
16. Yaptığınızın yanınıza kâr kaldığı	O	O	O	O	O	O		38.Güvenli	O	O	O	O	O	O
17. Değersiz olduğunuz hissini veren	O	O	O	O	O	O		39.İşlevsel	O	O	O	O	O	O
18. Hareketli	O	O	O	O	O	O		40. Akışkan	O	O	O	O	O	O
19.Gerginliklere neden olan	O	O	O	O	O	O		41.Trafik kuralları bilgisi gerektiren	O	O	O	O	O	O
20.Önleyici tedbirler içeren	O	O	O	O	O	O		42.Davranışlarınızı yönlendiren	O	O	O	O	O	O
21.Denetim altında	O	O	O	O	O	O		43.Ne olacağı belli olmayan	O	O	O	O	O	O
22.Bir yerden bir yere kolayca seyahat edilen	O	O	O	O	O	O		44.Yoğun	O	O	O	O	O	O

E: MULTIDIMENSIONAL TRAFFIC LOCUS OF CONTROL SCALE

Kazaların Nedenleri

Kendi sürüş tarzınızı ve koşullarınızı düşündüğünüzde, aşağıdaki faktörlerin bir kazaya yol açmasının ne kadar olası olduğunu düşünüyorsunuz?

		1: Hiç olası değil				**5:Büyük olasılıkla (ihtimalle)**
1.	Araç kullanma becerilerimin yetersizliği	1	2	3	4	5
2.	Araç kullanırken yaptığım riskli davranışlar	1	2	3	4	5
3.	Diğer sürücülerin araç kullanma becerilerinin yetersizliği	1	2	3	4	5
4.	Diğer sürücülerin araç kullanırken yaptığı riskli davranışlar	1	2	3	4	5
5.	Kötü şans (veya şanssızlık)	1	2	3	4	5
6.	Bozuk ve tehlikeli yollar	1	2	3	4	5
7.	Aşırı sürat yapmak	1	2	3	4	5
8.	Diğer sürücülerin aşırı sürat yapması	1	2	3	4	5
9.	Öndeki araçları çok yakından takip edip etmemek	1	2	3	4	5
10.	Diğer araç sürücülerinin kullandığım aracı yakın takip etmeleri	1	2	3	4	5
11.	Kader	1	2	3	4	5
12.	Kötü hava ve aydınlatma koşulları	1	2	3	4	5
13.	Araçtaki mekanik bir arıza	1	2	3	4	5
14.	Diğer sürücülerin alkollüyken araç kullanması	1	2	3	4	5
15.	Diğer sürücülerin tehlikeli bir şekilde hatalı sollama yapması	1	2	3	4	5
16.	Tehlikeli bir şekilde hatalı sollama yapmak	1	2	3	4	5
17.	Tesadüf	1	2	3	4	5

F: DRIVER SKILLS INVENTORY

Araç kullanırken güçlü ve zayıf yönleriniz nelerdir?
Sürücüler arasında, özellikle farklı sürüş bileşenlerinde birçok farklılık vardır. Hepimizin güçlü ve zayıf sürücü yönlerimiz vardır. Lütfen sizin, bir sürücü olarak güçlü ve zayıf yönlerinizin neler olduğunu her bir madde için aşağıdaki uygun seçeneği işaretleyerek belirtiniz.

1= Çok Zayıf 2= Zayıf 3= Ne Zayıf Ne Güçlü
4= Güçlü 5= Çok Güçlü

		1: Çok zayıf	**2: Zayıf**	**3: Ne zayıf ne güçlü**	**4: Güçlü**	**5: Çok güçlü**
1	Seri araç kullanma	1	2	3	4	5
2	Trafikte tehlikeleri görme	1	2	3	4	5
3	Sabırsızlanmadan yavaş bir aracın arkasından sürme	1	2	3	4	5
4	Kaygan yolda araç kullanma	1	2	3	4	5
5	İlerideki trafik durumlarını önceden kestirme	1	2	3	4	5
6	Belirli trafik ortamlarında nasıl hareket edileceğini bilme	1	2	3	4	5
7	Yoğun trafikte sürekli şerit değiştirme	1	2	3	4	5
8	Hızlı karar alma	1	2	3	4	5
9	Sinir bozucu durumlarda sakin davranma	1	2	3	4	5
10	Aracı kontrol etme	1	2	3	4	5
11	Yeterli takip mesafesi bırakma	1	2	3	4	5
12	Koşullara göre hızı ayarlama	1	2	3	4	5
13	Geriye kaçırmadan aracı yokuşta kaldırma	1	2	3	4	5
14	Sollama	1	2	3	4	5
15	Gerektiğinde kazadan kaçınmak için yol hakkından vazgeçme	1	2	3	4	5
16	Hız sınırlarına uyma	1	2	3	4	5
17	Gereksiz risklerden kaçınma	1	2	3	4	5
18	Diğer sürücülerin hatalarını telafi edebilme	1	2	3	4	5
19	Trafik ışıklarına dikkatle uyma	1	2	3	4	5
20	Dar bir yere geri geri park edebilme	1	2	3	4	5

G: DEBRIEFING FORM

KATILIM SONRASI BİLGİ FORMU

Bu araştırma, ODTÜ Psikoloji Bölümü Trafik ve Ulaşım Psikolojisi doktora programı öğrencisi Arş. Gör. İbrahim Öztürk tarafından Doç. Dr. Henriette Wallén Warner ve Prof. Dr. Türker Özkan danışmanlığında yürütülmektedir. Çalışmanın amacı, sürücülerin farklı bireysel özelliklerinin ve trafik sistemi ile ilgili özelliklerin sürücülerin farklı seviyelerdeki otonom araçlara karşı kabüllerine etkisinin araştırılmasıdır.

Bu çalışmadan alınacak ilk verilerin Ocak 2020 sonunda elde edilmesi amaçlanmaktadır. Elde edilen bilgiler sadece bilimsel araştırma ve yazılarda kullanılacaktır. Çalışmanın sağlıklı ilerleyebilmesi ve bulguların güvenilir olması için çalışmaya katılacağını bildiğiniz diğer kişilerle çalışma ile ilgili detaylı bilgi paylaşımında bulunmamanızı dileriz. Bu araştırmaya katıldığınız için tekrar çok teşekkür ederiz.

Araştırmanın sonuçlarını öğrenmek ya da daha fazla bilgi almak için araştırmacılara başvurabilirsiniz.

İbrahim Öztürk (ozturki@metu.edu.tr)
Doç. Dr. Henriette Wallén Warner (henriette.wallen.warner@vti.se)
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Çalışmaya katkıda bulunan bir gönüllü olarak katılımcı haklarınızla ilgili veya etik ilkelerle ilgi soru veya görüşlerinizi ODTÜ Uygulamalı Etik Araştırma Merkezi'ne iletebilirsiniz.

E-posta: ueam@metu.edu.tr

H: CURRICULUM VITAE

İBRAHİM ÖZTÜRK

EDUCATION

2017 – 2021 : Middle East Technical University, Ankara.
Ph.D., Psychology, Traffic and Transportation Psychology

2015 – 2017 : Middle East Technical University, Ankara.
M.Sc., Psychology, Traffic and Transportation Psychology

2010 – 2015 : Middle East Technical University, Ankara.
B.S., Psychology

WORK EXPERIENCE

Research Assistant: Middle East Technical University, 2018 - 2021
Research Assistant: Çanakkale Onsekiz Mart University, 2017 - 2018

PUBLICATIONS

Budak, N., **Öztürk, İ.**, Aslan, M., & Öz B. (2021). How drivers' risk perception changes while driving on familiar and unfamiliar roads: A comparison of female and male drivers. *Trafik ve Ulaşım Araştırmaları Dergisi, 4*(1), 39–48. doi: 10.38002/tuad.866934

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CONFERENCES PRESENTATIONS

Oral Presentations – International

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Workshop – National

Tekeş, B., & **Öztürk, İ.** (2018). An observational study of seat-belt. Workshop in 20th National Congress of Psychology, Ankara–Turkey.

Tekeş, B., & **Öztürk, İ.** (2018). Field research in traffic and transportation psychology: An observational study of seat-belt. Workshop in 22th National Psychology Students Congress, Kayseri–Turkey.

PROJECTS

Project Assistant in Task Performance and Contextual Performance in Traffic (2016, Middle East Technical University Scientific Research Projects, Project Manager: Assoc. Prof. Dr. Bahar Öz)

SYNERGISTIC ACTIVITIES

Editorial duties

Trafik ve Ulaşım Araştırmaları Dergisi: Managing Editor, Technical Editor

Peer-review activities in journals

Advances in Transportation Studies: An international Journal
Trafik ve Ulaşım Araştırmaları Dergisi

Awards

Swedish Institute – Swedish-Turkish Scholarship Programme 2019
French Embassy Research Fellowships for PhD Students 2019
METU Graduate Courses Performance Award (Doctoral degree)
METU Graduate Courses Performance Award (Master's degree)

I: TURKISH SUMMARY / TÜRKÇE ÖZET

Giriş

Dünya Sağlık Örgütü'nün (2018) verilerine göre karayolu trafik kazaları önde gelen halk sağlığı problemlerinden biri olarak karşımıza çıkmaktadır. Bu kazalar tüm yaş grupları için ölüm nedenleri arasında sekizinci sırada yer alırken 5 ile 29 yaş arasındaki bireylerde ise birinci sırada yer almaktadır. Dünya genelinde toplamda ise ortalama 1.35 milyon insan her yıl karayollarında hayatını kaybetmektedir. Bu sayılar 2015 yılındaki rapora kıyasla son 3 yılda yaklaşık 150000 artmış ve ölüm nedenlerinde trafik kazalarının birinci sırada olduğu yaş aralığı 15-29'dan 5-29'a genişlemiştir (WHO, 2015; 2018). Bu kazaların toplum sağlığına etkisi düşünüldüğünde bu alandaki çalışmalar ayrı bir önem kazanmaktadır. Otonom araçlar ise son yıllarda ulaşım ile ilgili çalışmalarda özellikle öne çıkmaktadır. Teknolojik gelişmelerle birlikte otonom araçlar kaza, yaralanma ve ölüm gibi trafikteki olumsuz çıktıları azaltma konusunda büyük potansiyel taşımaktadır. Bu açıdan ele alındığında otonom araçlara karşı tutum ve bunu etkileyen faktörlerin çalışılması da ayrı bir önem taşımaktadır.

Otonom Araçlar ve Yol Kullanıcılarının Kabulü

SAE International Standard J3016'a göre araçlar teknik özelliklerine ve sistem becerilerine göre altı seviyede sınıflandırılabilmektedir. Bu seviyeler; 0: Sıfır Otomasyon, 1: Sürüş Asistanı, 2: Kısmi Otomasyon, 3: Koşullu Otomasyon, 4: Yüksek Otomasyon ve Seviye 5: Tam Otomasyon olarak isimlendirilmiştir. Seviye arttıkça otonom sistemin sürüş ile ilgili gerçekleştirdiği görevler artmakta ve trafikte daha geniş bir alana hâkim olmaktadır. Daha detaylı incelediğimizde ise seviye 0 tüm sürüş görevlerinin sürücü tarafından yapıldığı araç türüdür. Birinci seviyede ise sürüş görevlerinin çoğu sürücü tarafından gerçekleştiriliyor olsa da bazı görevler ile sistem sürücüye yardımcı olmaktadır. Kısmi otomasyonda hız ve direksiyon kontrolü sistem tarafından gerçekleştirilebilse de sürücü çevresini sürekli kontrol etmek zorundadır. Koşullu otomasyonda ise otonom sistem birçok görevi kendi başına yapabiliyor olsa da sürücü acil durumlarda aracın kontrolünü ele almak için sürekli hazır olmalıdır. Yüksek otomasyonda otonom sistem birçok koşulda sürüş ile ilgili tüm görevleri sürücüsüz gerçekleştirebilmektedir fakat sürücü dilediğinde sürüşün kontrolünü ele alabilir. Son olarak, tam otomasyonda ise sürüş ile ilgili tüm işlemler sistem tarafından gerçekleştirilir. Sürücünün sadece varış noktasını girmesi gerekmektedir (SAE, 2016).

Otonom araçların faydalarına ilişkin birçok çalışma yapılmaktadır. Örneğin, Chan (2017) tarafından otonom sistemlerin hâkim olduğu bir trafik sisteminde daha az kazanın gerçekleşeceğini ve sistemin sürücüler açısından daha az talepkâr olacağını ileri sürmüştür. Böylece daha erişilebilir, daha verimli altyapısı olan ve daha etkili bir ulaşım ağına sahip bir sistem gerçekleştirilebilir. Benzer bir şekilde, Alessandrini ve ark. (2015) da otonom araçların çevre, yaşlı ve engelli bireyler, bisikletli ve yaya yol kullanıcıları gibi birçok farklı alanda faydasının olacağını tartışmıştır. Nordhoff ve ark. (2016) tarafından da tartışıldığı gibi otonom araçların kabulü ile ilgili çalışmalar sistemin hayata geçişinde önemli bir belirleyici role sahiptir.

Otonom araçlar ile ilgili tutum ve niyet çalışmalarında yaş ve cinsiyet açısından alanyazında tutarsız bulgular bulunmaktadır. Örneğin, Buckley ve ark. (2018) tarafından gerçekleştirilen çalışmada yaş ve cinsiyetin otonom araç kullanmaya karşı niyet ile bir ilişkisi bulunmamıştır. Schoettle ve Sivak (2014) ise gençlerin bağlantılı araçlara daha olumlu tutum sergilediğini bulmuştur. Hohenberger ve ark. (2016) da erkeklerin otonom araçları kullanma olasılığının kadınlardan daha yüksek olduğunu bulmuştur. Hulse ve ark. (2018) ise genç sürücülerin ve erkek sürücülerin otonom araçlara karşı olumlu tutumlarının olduğu bulmuştur. Tüm bu farklılıklara rağmen, yaş ve cinsiyetin etkisi diğer psiko-sosyal faktörlerin denkleme girmesi sonucu ya zayıflamış ya da tamamen kaybolmuştur (Nordhoff ve ark., 2019).

Her ne kadar otonom araçların trafik güvenliğine olumlu etkisine ilişkin çeşitli çalışmalar olsa da farklı çalışmalarda bazı kritik durumlar da ele alınmıştır. Noy ve ark. (2018) tarafından gerçekleştirilen çalışmada otonom araçlarla birlikte sürücü hatası kavramının değişeceği, uygun olmayan algoritmalar ve sistem hataları sonucunda gerçekleşen yeni tiplerde trafik kazalarının görüleceği öne sürülmüştür. Benzer bir şekilde, yüksek seviyedeki otonom araçlarda sistemin sürüşü sürücüye devretmesi gereken durumlar ayrı bir riskli durum göstermektedir. Ayrıca, Pradhan ve ark. (2018) ise bu tür sistemlerin özellikle yaşlı ve tecrübesiz sürücüler için faydalı olacağı düşünülse de sisteme fazla güvenilmesi, teknolojik hatalar, teknoloji veya dikkat dağıtıcı diğer aktivitelerle aşırı yüklenmek gibi genel kaygılar da bulunmaktadır.

Otonom araçlarla ilgili çalışmaları incelerken ele alınması gereken en önemli konulardan bir tanesi de bu araçlar halihazırda güncel trafik sisteminin bir parçası olmaması ve haklarında yeterli bilgi bulunmamasıdır (Buckley ve ark., 2018). Bu problemin önüne geçmek için bölüm 2.2.6.'da da belirtildiği gibi katılımcılardan altı otonom seviye içerisinden kendilerinin en çok tercih ettiği otonom araç seviyesini belirtmeleri istenmiştir. Genel olarak, otonom araçların güvenlik açısından faydaları ve oluşturduğu kaygılar ile yol kullanıcılarının bu araçlara karşı tutumları ele alındığında mevcut çalışma sürücülerin en çok tercih ettiği otonom araç seviyesine etki eden faktörler ile ilgilenmektedir. Bu amaç doğrultusunda trafik iklimi, trafik kontrol odağı ve sürüş becerilerinin sürücülerin en çok tercih ettiği otonom araç seviyesine olan etkisi araştırılmaktadır.

Trafik İklimi

Yol güvenliğinin arttırılması ve trafik kazaları gibi istenmeyen çıktıların azaltılması için önemli faktörlerden biri de trafik iklimidir (Chu ve ark., 2019). Özkan ve Lajunen (2011) trafik iklimini yol kullanıcılarının (örn. sürücülerin) trafikte belirlenen bir zamanda trafiğe ilişkin tutum ve algıları olarak tanımlamaktadır. Bir başka çalışmada, trafik iklimi kişinin kendi becerilerinin yanı sıra algılanan özellikle ve dinamik yönleriyle birlikte bir duruma hâkim olabilme işlevi olarak tanımlamaktadır (Gehlert ve ark., 2014). Tanımı özelinde bakıldığında ise trafik iklimi algısı trafik ortamı ve koşullarına göre değişiklik göstermektedir (Chu ve ark., 2019). Trafik iklimi farklı uygulamaları, politikaları, prosedürleri, rutinleri ve yaptırımları içermektedir. Pozitif bir trafik iklimi sağlandığında sürücüler diğer yol kullanıcıları ve trafik ortamıyla verimli etkileşimler deneyimleyecektir (Chu ve ark., 2019).

Özkan ve Lajunen'nin (2011) geliştirdiği teorik tartışmanın üstüne Özkan ve Lajunen (yayınlanmamış) tarafından trafik ikliminin ölçülmesi amacıyla Trafik İklimi Ölçeği (TİÖ) geliştirilmiştir. Gehlert ve ark. (2014) tarafından yapılan çalışmada ölçeğin üç temel faktör gösterdiği bulunmuştur. Bu faktörler dışsal duygu talepleri, işlevsellik ve içsel gereksinimler boyutlarıdır. Dışsal duygu talepleri trafik ile etkileşim halindeyken yol kullanıcılarının duygusal katılımı ile ilgilidir. İçsel gereksinimler ise başarılı bir şekilde trafik sisteminin bir parçası olabilmek için gerekli olan bireysel beceriler ve yeteneklerdir. Son olarak ise işlevsellik işlevsel bir trafik sisteminin gereklilikleriyle alakalıdır (Gehlert ve ark., 2014).

Birçok farklı çalışmada trafik güvenliği ile ilgili demografik değişkenler ile trafik iklimi boyutları arasında çeşitli ilişkiler bulunmuştur. Örneğin, Chu ve ark. (2019) tarafından yapılan çalışmada yaş, cinsiyet ve ehliyet sahibi olunan süre işlevsellik ile negatif korelasyon göstermiştir. Başka bir çalışmada ise yaş işlevsellik ile pozitif, içsel gereksinimler ile negatif korelasyon göstermiştir. Ayrıca, erkek olmak dışsal duygu talepleriyle pozitif ilişkili bulunmuştur (Zhang ve ark., 2018). Qu ve ark. (2019) tarafından yapılan çalışmada ise yaş ile dışsal duygu talepleri ve içsel gereksinimler arasında negatif, işlevsellikle ise pozitif korelasyon bulunmuştur. Üzümcüoğlu ve ark. (2019) tarafından yapılan bir çalışmada hayat boyu kat edilen kilometre Türkiye'de dışsal duygu talepleriyle pozitif ilişki gösterirken Çin'de negatif ilişki göstermiştir.

Trafik iklimi ve kazalar arasındaki ilişkiye bakıldığında ise dışsal duygu taleplerinin yüksek olması sürücüleri daha çok ihlal yapmaya ve bu yüzden de daha fazla kaza deneyimlemeye itebilmektedir (Chu ve ark., 2019; Gehlert ve ark., 2014). Bunun aksine, içsel gereksinimler sapkın sürücü davranışlarına bir tampon görevi görerek daha az kaza deneyimlemeyi beraberinde getirebilir (Chu ve ark., 2019).

Genel olarak bakıldığınsa ise Gehlert ve ark. (2014) tarafından işlevselliği yüksek ve dışsal duygu talebi düşük trafik sistemlerinin daha az riskli ve yol kullanıcıları için daha güvenli algılanabileceğini öne sürmüştür. Benzer bir şekilde, Chu ve ark. (2019) da işlevselliğin ve içsel gereksinimlerin sapkın sürücü davranışlarıyla negatif, olumlu sürücü davranışlarıyla pozitif ilişki gösterdiğini bulmuştur. Ülkeler arası farklılıklara bakıldığında ise Üzümcüoğlu ve ark. (2019) Çin'in trafik sisteminin Türkiye'deki trafik sistemine göre daha yüksek dışsal duygu talebi ve işlevsellik gösterdiğini bulgulamıştır. Buna karşılık, Türkiye'nin trafik sistemi içsel gereksinimler açısından daha yüksek değerlendirilmiştir.

Qu ve ark. (2019) tarafından yapılan çalışmada dışsal duygu taleplerinin otonom sistem ile ilgili kaygılarla pozitif ilişkili olduğu bulunmuştur. Ayrıca, içsel gereksinimlerin de otonom araçların kabulü ile ilgili farklı faktörler ile pozitif ilişkili olduğu görülmüştür. Son olarak, işlevsellik ise otonom sistemlerin faydaları ve sistem endişeleri ile pozitif ilişki gösterirken kaygı senaryoları ile negatif ilişki göstermiştir. Ayrıca, trafik ikliminin otonom araçların kabulünde önemli bir değişken olduğu görülmüştür (Qu ve ark., 2019).

Trafik ikliminin sürücü davranışları ve trafik kazaları gibi trafik güvenliği ile ilgili çıktılarla ilişkileri göz önüne alındığında, sürücülerin trafik sistemi ile ilgili algılarının tercih edecekleri otonom araç seviyesi ile ilişkili olacağı düşünülmektedir. Başka bir deyişle, trafik sistemi sürücülerin gözünde oluşturduğu algı üzerinden sürücülerin hangi seviyede otonom araçları tercih edeceğinde belirleyici rol oynayabilir. Örneğin, trafik sisteminin dışsal duygu talepleri açısından yüksek olması sürücülerin daha yüksek seviyelerde otonom araçlar tercih etmesine neden olabilir.

Trafik Kontrol Odağı

Trafik güvenliği ile ilişkili faktörlerden bir tanesi de kontrol odağı veya trafik kontrol odağıdır. Kontrol odağı, Rotter (1966) tarafından kişilerin olayları kendilerinin veya başkalarının kontrolü altında algılaması olarak tanımlanmıştır. Kişi eğer olayları kendi kontrolü altında algılıyorsa bu iç kontrol odağı, başkalarının veya dış faktörlerin kontrolü altında algılıyorsa bu dış kontrol odağı olarak isimlendirilmektedir (Rotter, 1966). Genel kontrol odağına ek olarak Montag ve Comrey (1987) tarafından sürüş özelinde kontrol odağı kavramı geliştirilmiştir. Bu sınıflandırmaya göre ise sürücü kontrol odağı sürücü iç kontrol odağı ve sürücü dış kontrol odağı olmak üzere iki grupta ele alınmaktadır. Sürücü iç kontrol odağı güvenli sürücülük ile ilişkilendirilirken sürücü dış kontrol odağı ise kazalara dahil olma ile pozitif ilişkili bulunmuştur. Trafik odaklı başka bir kontrol odağı çalışmasında Özkan ve Lajunen (2005) Çok Boyutlu Trafik Kontrol Odağı Ölçeği'ni geliştirmiştir. Bu ölçeğe göre trafik kontrol odağı, kendi, araç ve çevre, kader ve diğer sürücüler olmak üzere dört boyuttan oluşmaktadır. Ölçeğin Wallén Warner ve ark. (2010) tarafından gerçekleştirilen İsveç uyarlamasında ise diğer sürücüler, araç ve çevre, kader, kendi davranışları ve kendi becerileri olmak üzere beş boyut bulunmuştur.

Özkan ve Lajunen (2005) tarafından yapılan çalışmada yaş ve ehliyet süresi trafik kontrol odağı ile ilişkili bulunmazken hayat boyu kat edilen kilometre kader ile pozitif ilişkili çıkmıştır. Aynı zamanda kadın olmak araç ve çevre ve diğer sürücüler boyutlarıyla ilişkili bulunmuştur (Özkan ve Lajunen, 2005). Măirean ve ark. (2017) tarafından yapılan çalışmaya göre ise erkek sürücüler kazaları daha çok diğer sürücülere ve araç ve çevre faktörlerine atfederken kadın sürücüler daha çok kader ve şans faktörlerini kullanmaktadır.

Özkan ve Lajunen (2005) aynı zamanda iç kontrol odağı boyutu olan kendi boyutu yüksek sürücülerin aynı zamanda daha fazla kaza, cezai saldırgan ihlaller, sıradan ihlaller ve hatalar raporladığını belirtmiştir. Ayrıca, araç ve çevre faktörü hatalar ile pozitif, cezalar ile negatif ilişki göstermiştir. Genel olarak ise kazaların nedenlerini içsel faktörlere atfeden genç sürücüler, dışsal faktörlere atfeden diğer sürücülere kıyasla daha fazla kaza deneyimlemektedir. Buna karşın, Lucidi ve ark. (2010) tarafından yapılan bir çalışmaya göre sürücü dış kontrol odağı ihlaller, hatalar ve sapmalar ile pozitif ilişki göstermiştir. Aynı zamanda sürücüler arasında yapılan gruplandırmalar sonucunda en güvenli sürücü grubu kontrol odağı açısından yüksek iç kontrol odağına sahiptir. Măirean ve ark. (2017) tarafından yapılan çalışmada ise yüksek riskli sürücü grubunun orta veya yüksek seviyede dış kontrol odağı ve düşük seviyede iç kontrol odağı raporladığı görülmüştür.

Bıçaksız ve ark. (2019) tarafından yapılan bir çalışmada ise trafik kontrol odağı ile otonom araçların kabulü araştırılmıştır. Kader otonom araçların kabulü ile pozitif ilişkili bulunmuştur. Daha önce tartışıldığı gibi, otonom araçlar trafik güvenliği için birçok çıktı vadetmektedir. Otonom araçların trafik kazalarına etkisine ilişkin farklı bakış açıları göz önüne alındığında, sürücülerin kazaların nedenlerinin nasıl yorumladıklarının da otonom araç tercihlerinde etkili olacağı düşünülmektedir. Öte yandan, otonom araç seviyelerindeki farklılıklar sürücülere trafikte farklı durumları etkileyebilecek farklı seçenekler sunmaktadır. Aracın kontrolünü sürücü dışındaki bir sistem ile paylaşmak veya tamamen sisteme bırakmak kaza, yaralanma veya ölüm gibi durumlar için tamamen yeni bir faktör oluşturmaktadır. Bu durumda, sürücülerin kaza nedenlerine ilişkin atıf farklılıkları trafik durumlarını da farklı değerlendirmeleri ile ilişkilendirilebilir. Bu da aynı zamanda otonom araçların farklı algılanması ile ilişkilendirilebilir. Örneğin, trafik kazalarını araç hatalarına atfeden sürücüler otonom seviyelerde daha düşük seviyeleri tercih edebilirler. Aksine, kaza nedenlerini içsel faktörlere atfeden sürücüler daha yüksek seviyeleri tercih edebilirler.

Sürüş Becerileri

Parker ve Stradling (2001) tarafından sürücülük ile alakalı sürücü faktörleri sürücü davranışları ve sürüş becerileri olmak üzere iki temel boyutta incelenmektedir. Sürücü davranışları sürücülerin sürüş sırasında gösterdiği davranışlarla ilgilenirken, sürüş becerileri ise sürücülerin yapabildikleri ile alakalıdır (Elander ve ark., 1993; Lajunen ve Özkan, 2011). Lajunen ve Summala (1995) tarafından sürüş becerileri algısal-motor beceriler ve güvenlik becerileri olmak üzere iki temel boyutta Sürüş Becerileri Ölçeği (SBÖ) ile ölçülmektedir.

Her ne kadar bazı çalışmalarda (Öztürk ve Özkan, 2018; Xu ve ark., 2018) yaş ile sürüş becerileri arasında bir ilişki bulunmasa da, Özkan ve Lajunen (2006) yaş ile algısal-motor beceriler arasında pozitif, Ostapczuk ve ark. (2017) ise yaş ile hem algısal-motor hem de güvenlik becerileri arasında pozitif ilişki bulmuştur. Ayrıca, Özkan ve Lajunen (2006) kadın sürücülerin erkeklere kıyasla daha yüksek güvenlik becerileri ve daha düşük algısal-motor beceriler raporladığını bulmuştur. Ostapczuk ve ark. (2017) tarafından yapılan başka bir çalışmada ise kadın sürücülerin daha yüksek güvenlik becerileri raporladığını bulunurken algısal-motor beceriler açısından fark anlamlı değildir. Farklı çalışmalarda trafiğe maruz kalma ile ilgili değişkenler incelendiğinde ehliyet süresi (Ostapczuk ve ark., 2017), son bir yılda kat edilen kilometre (Öztürk ve Özkan, 2018; Xu ve ark., 2018b) ve hayat boyu kat edilen kilometre (Ostapczuk ve ark., 2017; Xu ve ark., 2018) benzer şekilde algısal-motor beceriler ile pozitif ilişki göstermiştir.

Özkan ve Lajunen (2006) tarafından yapılan çalışmada algısal-motor becerileri yüksek sürücülerin daha fazla kaza deneyimleyen ve daha fazla cezası olan sürücüler olduğu görülmüştür. Güvenlik becerileri ise hem Yunanistan ve hem Türkiye'deki sürücülerde kazalara dahil olma ile negatif ilişki göstermiştir. Benzer bir şekilde, Ostapczuk ve ark. (2017) ve Xu ve ark. (2018b) da güvenlik becerileri ile trafikte alınan cezalar arasında negatif ilişki bulmuştur.

Sürüş becerilerinin sürücülükte insan faktörlerinin temel bir boyutlarından biri olduğu ve birçok trafikle ilgili çıktı ile etkileşim içinde bulunduğu düşünüldüğünde algısal-motor becerilerin ve güvenlik becerilerinin otonom araç tercihleriyle farklı ilişki örüntüleri göstereceği düşünülmektedir. Algısal-motor becerileri yüksek sürücülerin daha düşük seviyelerde araç tercih ederken güvenlik becerileri yüksek sürücülerin daha üst seviyelerde araç tercih edeceği beklenmektedir.

Türkiye ve İsveç'te Yol Güvenliği

Dünya Sağlık Örgütü'nün 2018 verilerine bakıldığında (WHO, 2018) trafik kazaları ve bu kazalara bağlı ölümlerde bölgesel ve ülkeler arası farklılık göze çarpmaktadır. Bu farklılıklardan biri de İsveç ve Türkiye arasında görülmektedir. Her 100000 nüfus başına tahmini ölüm oranlarına bakıldığında bu oran İsveç'te 2.8 iken Türkiye'de 12.3'dür. Trafik güvenliği ile ilgili yaptırımların etkinliğine bakıldığında ise İsveç güvenli sistem yaklaşımını en iyi uygulayan ülkelerden biridir (WHO, 2018). Aynı zamanda, önceki çalışmalarda da İsveç ve Türkiye'deki sürücüler arasında birçok farklılık sunulmuştur. Örneğin, Wallén Warner ve ark. (2011) çalışmasında İsveç'teki sürücüler hız limitlerine daha çok uyduklarını raporlamıştır. Başka bir çalışmada ise, Türkiye'deki sürücüler daha yüksek güvenlik becerileri raporlamıştır (Wallén Warner ve ark., 2013).

Çalışmanın Amacı

Trafik ortamına farklı seviyelerdeki otonom araçların dahil edilmesiyle birlikte trafik sistemine anlamlı farklılıklar oluşabilecektir. Bu değişiklikler sonucunda sürücüler trafik sistemine farklı algılayabilir ve davranışlarını ve ihtiyaçlarını buna göre düzenleyebilirler. Örneğin, Üzümcüoğlu ve ark. (2020a) bir ülkenin trafik ikliminin sürücü davranışlarında önemli rol oynadığını ve bu ilişkinin sürücü becerilerine göre değişebildiğini bulgulamıştır. Bu açıdan düşünüldüğünde genel anlamda iki yönlü bir ilişkinin olduğu varsayılabilir. Çalışmanın amaçları kapsamında mevcut trafik sistemine dair sürücülerin algısının sürücülerin hangi özellikteki araçları tercih edeceğine dair etkisinin olması beklenmektedir. Mevcut trafik sistemi dışsal duygu talepleri veya iç gereksinimler açısından yüksek olarak algılanırsa, sürücülerin trafik sisteminden gelen talep ve gereksinimleri karşılamak için daha yüksek otomasyon seviyelerini tercih edebilecekleri beklenmektedir. Bunun aksine, trafik sistemini işlevsellik açısından yüksek algılayan sürücüler, daha yüksek otomasyon seviyelerine yönelik anlamlı bir eğilim göstermeyebilir.

Özkan ve Lajunen (2005) tarafından vurgulandığı gibi trafik kontrol odağı sürücülerin trafik kazalarının nedenleri atfettikleri faktörler ile ilgilidir. Noy ve ark. (2018) tarafından da tartışıldığı gibi otonom araçların trafik kazalarına olası etkileri düşünüldüğünde sürücülerin kazaları atfetme şekillerinin bu araçlara yönelik tercihlerinde etkilerinin olması beklenmektedir. Trafik kazalarını iç faktörlere atfeden sürücülerin, daha yüksek seviyelerde otomasyonu tercih etme eğiliminde olması beklenmektedir. Bu sürücüler, kazaların kendi becerileri ve davranışları nedeniyle gerçekleştiğini düşündükleri için, otonom sisteme daha fazla kontrol vermek isteyebilirler. Öte yandan, trafik kazalarını dış etkenlere (yani araç hataları, diğer sürücüler) bağlayan sürücülerin daha düşük seviyelerde otonom araçları tercih etmesi beklenmektedir.

Ayrıca, otonom araçlar sürüş ile ilgili farklı teknolojilerini de kullanıma sunmaktadır. Bu açıdan bakıldığında, bu teknolojik gelişmeleri tercih ederken sürüş becerilerinin etkisi olabileceği düşünülmektedir. Sürücüler kendi becerilerini mevcut olan araçlara göre değerlendiriyor olabilirler. Bu nedenle yeni teknolojiler veya farklı seviyedeki otonom araçlar sürücülerin kendilerini eksik gördükleri beceriler için telafi edici bir faktör olabilir. Bunlar ışığında, sürüş becerilerinin sürücülerin en çok tercih edeceği otonom araç seviyesi ile ilişkili olması beklenmektedir. Algısal-motor becerileri daha yüksek olan sürücülerin, daha düşük seviyelerde otonom araçları tercih etmesi beklenmektedir. Bunun aksine, daha yüksek güvenlik becerilerine sahip sürücüler, daha yüksek seviyelerde otomasyonu tercih edeceklerdir.

Sonuç olarak, mevcut çalışmada otonom araç seviyesi tercihlerinde ülke ve cinsiyet farklılığı ve trafik iklimi, trafik kontrol odağı ve sürüş becerilerinin etkileri incelenmektedir. Önerilen modele göre, trafik kontrol odağı ve sürüş becerilerinin otonom araç tercihleri ile olan ilişkisinin trafik ikliminden farklı şekillerde etkilenmesi beklenmektedir. Bu ilişkide, karayolu güvenliği istatistiklerindeki farklılıklara dayalı olarak, trafik ikliminin rolünün Türkiye ve İsveç arasında farklılık göstermesi beklenmektedir. Daha yüksek dışsal duygu talepleri ve iç gereksinimler, iç kontrol odağı ve güvenlik becerileri ile otonom araç tercihleri arasındaki ilişkide pozitif yönde güçlendirici bir role sahip olacaktır. Ayrıca bu düzenleyici etkilerin Türkiye ve İsveç'te farklılık göstermesi beklenmektedir.

Yöntem

Katılımcılar

Türkiye

Çalışmanın Türkiye uygulamasına 18 ve 38 yaşları arasında (*Ort.* = 22,41, *SS* = 2,77) toplam 318 kişi katılmıştır. Katılımcıların 105'i erkek ve 213'ü kadındır. Bütün katılımcılar üniversite öğrencisi ve geçerli B sınıfı ehliyet sahibidir (Ehliyet süresi *Ort.* = 3,03, *SS* = 2,47). Son bir yılda ortalama 5374,37 kilometre (*SS* = 11938,40) araç kullanmışlardır. Ayrıca, son üç yılda ortalama 0,59 (*SS* = 1,24) aktif kaza ve 0,25 (*SS* = 0,58) pasif kaza deneyimlemişlerdir.

İsveç

Çalışmanın İsveç uygulamasına 20 ve 55 yaşları arasında (*Ort.* = 28.80, *SS* = 8,53) toplam 312 kişi katılmıştır. Katılımcılardan 124'i erkek, 186'ü kadın ve 2'si diğer cinsiyet kimliklerini belirtmişlerdir. Bütün katılımcılar üniversite öğrencisi ve geçerli B sınıfı ehliyet sahibidir (Ehliyet süresi *Ort.* = 9,03, *SS* = 8,10). Son bir yılda ortalama 9133,21 kilometre (*SS* = 16635,13) araç kullanmışlardır. Ayrıca, son üç yılda ortalama 0,21 (*SS* = 0,49) aktif kaza ve 0,14 (*SS* = 0,40) pasif kaza deneyimlemişlerdir.

Materyaller

Demografik Bilgi Formu

Katılımcılara yaş, cinsiyet ve sürüş ile ilgili son bir yılda kat edilen kilometre gibi değişkenleri içeren demografik bilgi formu iletilmiştir.

Trafik İklimi Ölçeği

Özkan ve Lajunen (yayınlanmamış) tarafından yol kullanıcılarının ülkenin trafik sistemini belirli özellikler açısından değerlendirdikleri ölçek dışsal duygu talepleri, içsel gereksinimler ve işlevsellik olmak üzere üç boyutta geliştirilmiştir. Ölçek toplamda 44 maddeden oluşmakta ve 1 (Hiç tanımlamıyor) ile 6 (Tamamen tanımlıyor) arasında 6'lı Likert tipte değerlendirilmektedir. Mevcut çalışmada Üzümcüoğlu ve ark. (2020b) tarafından önerilen 16 maddelik versiyon test edilmiştir.

Çok Boyutlu Trafik Kontrol Odağı Ölçeği

Sürücülerin trafik kazalarını atfettikleri faktörleri değerlendirmek için Özkan ve Lajunen (2005) tarafından geliştirilen ölçek kendi, diğer sürücüler, araç ve çevre ve kader olmak üzere dört faktör ile değerlendirilmektedir. Mevcut çalışmada, Ölçeğin Türkçe (Özkan ve Lajunen, 2005) ve İsveççe (Wallén Warner ve ark., 2010) versiyonları kullanılmıştır. Katılımcılardan, kendi sürücü tarzlarını ve koşulları göz önünde bulundurarak, maddelerin bir kazaya hangi olasılıkta yol açabileceğine dair değerlendirmeleri istenmektedir. Ölçek 17 maddeden oluşmakta ve 1 (Hiç olası değil) ile 5 (Yüksek ihtimalle) arasında 5'li Likert tipte değerlendirilmektedir.

Sürüş Becerileri Ölçeği

Lajunen ve Summala (1995) tarafından sürücülerin trafikteki becerilerini algısal-motor beceriler ve güvenlik becerileri olmak üzere iki temel boyutta değerlendirmek amacıyla geliştirilmiştir. Çalışmada ölçeğin Türkçe (Lajunen ve Özkan, 2004) ve İsveççe (Wallén Warner ve ark., 2013) versiyonları kullanılmıştır. Ölçek toplamda 20 maddeden oluşmakta ve 1 (Çok zayıf) ile 5 (Çok güçlü) arasında 5'li Likert tipte derecelendirilmektedir.

Tercih Edilen Araç Otomasyonu Seviyesi

Sürücülerin en çok tercih ettiklerini otonom araç seviyesinin belirlenmesi amacıyla katılımcılara bir soru sorulmuştur. Bu soru "Aşağıda farklı seviyelerdeki otomasyon tanımları verilmiştir. Bir sürücü olarak, bu seviyelerden hangisini tercih edersiniz?" şeklinde formatlanmıştır (Bkz. Ek C.).

Prosedür

Orta Doğu Teknik Üniversitesi İnsan Araştırmaları Etik Kurulu'ndan alınan etik izin sonrasında veri toplanmasına başlanmıştır. Ölçeğin Türkçe ve İsveççe versiyonları Qualtrics üzerinden katılımcılara ulaştırılmıştır. Üniversite öğrencilerine kartopu ve uygun örneklem yöntemleri kullanılarak ulaşılmıştır. Katılımcı olabilmek için üniversite öğrencisi olmak ve B sınıfı ehliyet sahibi olmak gerekmektedir.

Analizler

Veri toplama işlemi tamamlandıktan sonra veriler SPSS v26 kullanılarak analiz edilmiştir. Öncelikle Türkiye ve İsveç'ten alınan örneklem demografik değişkenlere göre karşılaştırılmıştır. İkinci olarak, Promax rotasyonu ile temel bileşen analizleri, Türkiye ve İsveç verisi arasında ölçeklerin faktör yapılarını test etmek için gerçekleştirilmiştir. Elde edilen faktör yapılarına göre, döndürülmüş faktör matrisleri Procrustes hedef rotasyon tekniği kullanılarak karşılaştırılmıştır. Ayrıca, Türkiye'den alınan verilerin hedef faktör olarak kullanıldığı faktör uyumu katsayıları kullanılarak karşılaştırılarak üç ölçeğin faktör çözümlerinin eşdeğerliği incelenmiştir. van de Vijver ve Leugn (1997) ve ten Berge'nin (1986) önerilerine göre, .95'in üzerindeki değerler Türkiye ile İsveç arasında faktöriyel benzerlik anlamına gelirken .90'ın (van de Vijver ve Leugn, 1997) veya .85'in (ten Berge, 1986) altındaki değerler faktöriyel uyumsuzluklar olarak belirlenmiştir. Tanımlayıcı ve korelasyon analizleri ardından değişkenler arası ülke ve cinsiyet farklılıkları ve ülke içi cinsiyet farklılıkları test edilmiştir. Diğer cinsiyet kimlikleri yetersiz örneklem nedeniyle analizlere dahil edilmemiştir. Türkiye ve İsveç için yaş, son bir yılda kat edilen kilometre, cinsiyet, trafik iklimi, sürüş becerileri, trafik kontrol odağı etkilerini test etmek için altı hiyerarşik regresyon analizi yapılmış. Her regresyon analizinde, yaş, cinsiyet ve son bir yılda kat edilen kilometre kontrol değişkenleri olarak girilmiştir. Demografik değişkenlerin istatistiki etkisini kontrol ettikten sonra, trafik iklimi, trafik kontrol odağı ve sürüş becerilerinin boyutlarının sürücülerin tercih ettiği otonom araç seviyesine etkileri için ayrı ayrı aşamalı regresyon analizleri yapılmıştır.

Son olarak, çalışmanın önerilen modeline (Bkz. Şekil 1.) ve Hayes (2018) tarafından tanımlanan düzenleyici değişkenli düzenleyici değişken analizine dayanarak, trafik ikliminin trafik kontrol odağı/sürüş becerileri ile sürücülerin otonom araç tercihleri ilişkisi üzerindeki düzenleyici rolü ülkeye (Türkiye ve İsveç) bağlı olarak SPSS için PROCESS makrosu üçüncü model kullanılarak test edilmiştir. Morris ve ark. (1986), istatistiksel güçün etkileşim etkilerinde daha düşük olduğunu belirtmiştir. Bunun ışığında istatistiksel anlamlılığı belirlemek için p değeri .10 olarak belirlenmiştir.

Bulgular ve Tartışma

Trafik İklimi Ölçeği, Çok Boyutlu Trafik Kontrol Odağı Ölçeği ve Sürüş Becerileri Ölçeği için iki ülkede ayrı ayrı altı farklı temel bileşen analizi yapılmıştır. Trafik İklimi Ölçeği için yapılan temel bileşen analizlerinde Üzümcüoğlu ve ark. (2020b) tarafından önerilen 16 maddelik kısa versiyon kullanılmıştır. Bu maddeler temelinde yapılan analizler her iki ülke için de geçmiş çalışmalarda bulunan (Gehlert ve ark., 2014; Özkan ve Lajunen, yayınlanmamış; Üzümcüoğlu ve ark., 2020b) üç faktörlü (dışsal duygu talepleri, içsel gereksinimler ve işlevsellik) yapıyı desteklemiştir ve kabul edilebilir iç tutarlılık katsayıları göstermiştir.

Genel olarak bakıldığında maddelerin faktörlere dağılımı açısından İsveç örneklemi Üzümcüoğlu ve ark. (2020b) tarafından test edilen faktör dağılımını birebir yansıtmaktadır. Buna karşılık, Türkiye örnekleminde ise hem İsveç hem de Üzümcüoğlu ve ark. (2020b) tarafından test edilen yapıya göre üç madde farklı yüklenmiştir. Bunlar *saldırgan, stresli* ve *kaotik* maddeleridir. Bu maddelerde özellikle saldırgan ve stresli maddeleri dışsal duygu talepleri için temel maddeler olarak görülmelerine rağmen (Üzümcüoğlu ve ark., 2020), Türkiye'deki analizlerde içsel gereksinimlere yüklenmiştir. Bunun nedenlerinden biri olarak, Türkiye'deki trafik sisteminin genel olarak talepkâr, riskli ve beceri gerektiren bir sistem olduğu düşünüldüğünde (Üzümcüoğlu Zihni, 2018), sürücüler saldırgan veya stresli olmayı içsel bir durum olarak algılıyor olabilirler.

Çok Boyutlu Trafik Kontrol Odağı ölçeği ise alanyazında Wallén Warner ve ark. (2010) tarafından da raporlanan beş faktörlü yapıyı (araç ve çevre, kader, diğer sürücüler, kendi becerileri, kendi davranışları) kabul edilebilir iç tutarlılık katsayılarıyla birlikte göstermiştir. Sadece Türkiye'de beşinci faktör olan kendi davranışları faktörü içerik ve tutarlılık açısından problemli bir yapı sergilemiştir. Madde içeriklerine bakıldığında ise diğer sürücülere ve kendi becerilerine yönelik maddelerde iki temel madde ("*araç kullanma becerilerinin yetersizliği*" ve "*araç kullanırken yapılan riskli davranışlar*") görülmektedir. Ek olarak "*bozuk ve tehlikeli yollar*" maddesi ise İsveç örnekleminde önceki çalışmalara da benzer şekilde (Wallén Warner et al., 2010) kader maddesine yüklenmiştir. Son olarak, araç ve çevre faktörüne ilişkin bazı maddelerin diğer sürücülerle ilgili maddeler (Örneğin: "*diğer sürücülerin alkollüyken araç kullanması*") maddeler olduğu görülmüştür. Bu maddeler her ne kadar doğrudan diğer sürücülerle ilgili olsa da onların trafikte görünürlüğüyle ve trafik ortamının akışına olan genel etkileriyle alakalı yargı da içerdiği için araç ve çevre faktörüne yüklendiği düşünülmektedir.

Sürüş Becerileri Ölçeği alanyazındaki önceki çalışmalara (Lajunen ve Summala, 1995; Öztürk, 2017; Wallén Warner ve ark., 2013) benzer şekilde algısal-motor beceriler ve güvenlik becerileri olmak üzere iki temel boyutta bulunmuştur. Üç maddede ülkeler arası farklılık görülmüştür. İlk farklılık "*Diğer sürücülerin hatalarını telafi edebilme*" maddesinde bulunmuştur. Bu madde Türkiye'de algısal-motor becerilere yüklenirken İsveç'te güvenlik becerilerine yüklenmiştir. Bunun temel nedeninin İsveççe çevirisinde "sakince" ifadesinin de cümlede yer alması olarak düşünülmektedir. İkinci olarak "*Koşullara göre hızı ayarlama*" ifadesi İsveç'te güvenlik becerilerine yüklenirken Türkiye'de iki faktöre de ortak yüklenmiştir. Türkiye'de bazı katılımcılar tarafından bu ifade teknik beceri olarak hızını ayarlayabilme şeklinde yorumlanırken bazı katılımcılar tarafından güvenlik tercihlerinden ötürü hızını güvenli seviyede tutmak olarak ele alınmış olabilir. Son olarak "*Gerektiğinde kazadan kaçınmak için yol hakkından vazgeçme*" ifadesi ise Türkiye'de güvenlik becerileri içerisinde değerlendirilirken İsveç'te herhangi bir faktöre yüklenmemiştir. Wallén Warner ve ark. (2013) tarafından yapılan çalışmada da bu son iki maddenin tutarlılık göstermediği bulunmuştur. Bu açıdan ölçekteki özellikle bazı maddelerin tekrar yazılması veya tamamen ölçekten çıkarılması gelecek çalışmalarda ele alınabilir.

Son olarak, tüm faktörler için yapılan ülkeler arası uyumluluk değerlerine baktığımızda ise tam benzerlik işlevsellik, içsel gereksinimler ve kader boyutları için bulunmuştur. Aynı zamanda, tam benzerlik olmasa da kendi davranışları hariç diğer tüm boyutlar kabul edilir benzerlik değerleri görülmüştür.

Tanımlayıcı Analizler ve Korelasyonlar

Otonom araçlara yönelik genel olumlu tutumlar (Liljamo ve ark., 2018; Schoettle ve Sivak, 2014) ile karşılaştırıldığında, Türkiye'de sürücüler en çok ikinci seviye (kısmi otomasyon) ve İsveç'te sürücüler en çok sıfırıncı seviye (sıfır otomasyon) araçları tercih ederken her iki ülkede de dördüncü seviye (yüksek otomasyon) araçlar en az tercih edilen araçlar olmuştur. Benzer şekilde Bıçaksız ve ark. (2019), Türkiye'de katılımcıların çoğunun daha düşük otomasyon seviyesine sahip araçları kabul ettiğini bulmuştur. Bu durum, sürücülerin farkındalığı ve önerilen seçeneklerle ilgili deneyimleriyle de ilgili olabilir. Rodrigues ve ark. (2021), Portekizli sürücülerin çoğunun, otonom sürüş sistemli araçlara kıyasla piyasada bulunan araçları satın almayı tercih ettiğini bulmuştur. Bıçaksız ve ark. (2019)'a benzer şekilde yüksek otomasyonlu araçlar en az tercih edilen seçenektir. Liljamo ve ark. (2018), katılımcıların çoğunluğunun (%92) otonom işlevi kontrol etmek istediğini bulmuştur. Bu, aracı devralma durumunun yarattığı belirsizlikten kaynaklanıyor olabilir.

Önceki çalışmalardaki (Hartwich ve ark., 2019; Liljamo ve ark., 2018) yaş ve otonom araç tercihleri arasındaki bulgulara benzer şekilde, yaş, ehliyet yılı ve aktif ve pasif kaza sayıları gibi demografik değişkenler otonom araç tercihi ile ilişkilendirilmemiştir. Ancak, bu çalışmada sadece son bir yılda kat edilen kilometre ile Türkiye'deki araç tercihi arasında negatif bir korelasyon bulunmuştur. Ayrıca, yaş ve sürüş becerileri arasındaki pozitif ilişkilere benzer şekilde (Ostapczuk ve ark., 2017), yaş sadece Türkiye'deki güvenlik becerileri ve İsveç'teki algısal-motor beceriler ile pozitif yönde ilişkilidir. Chu ve ark. (2019)'nın bulgularını destekler bir şekilde, işlevsellik İsveç'teki yaş ile Türkiye ve İsveç'teki ehliyet sahibi olunan süre ile negatif korelasyon göstermiştir. Son olarak, trafik iklimi ve trafik kontrol odağı arasındaki ilişki açısından, dışsal duygu talepleri Türkiye'deki trafik kontrol odağının tüm faktörleri ve İsveç'teki kader ve diğer sürücüler boyutları ile pozitif olarak ilişkilendirilmiştir.

Ülke ve Cinsiyet Temelli Karşılaştırmalar

Türkiye ve İsveç örneklemlerinde yaş ve son bir yılda kat edilen kilometrenin kontrol değişkenleri olarak ele alındığı otonom araç tercihleri, dışsal duygu talepleri, işlevsellik, içsel gereksinimler, araç ve çevre, kendi becerileri, kader, diğer sürücüler, kendi davranışları, algısal-motor beceriler ve güvenlik becerileri için ayrı ayrı cinsiyet farklılığının incelendiği varyans analizleri yapılmıştır. Ardından, toplam örneklem üzerinde cinsiyet ve ülke farklılıklarının araştırılması için yaş ve son bir yılda kat edilen kilometrenin kontrol değişkeni olarak ele alındığı iki yönlü bağımsız gruplar için faktöryel varyans analizleri yapılmıştır. Aşağıda sırasıyla değişkenler için ülke içi ve tüm örneklem üstünden cinsiyet farklılığı, ülke farklılığı ve cinsiyet ve ülke etkileşim etkisi açıklanacaktır.

Türkiye örneklemindeki cinsiyet farklılıklarına yönelik analizlere göre, kadın sürücüler erkek sürücülerden daha düşük seviyelerde otonom araçları tercih etmiş ve daha düşük algısal-motor beceriler ve daha yüksek araç ve çevre ve içsel gereksinimler raporlamışlardır. Buna karşılık, İsveç örneklemindeki sonuçlara göre, kadın sürücüler daha yüksek diğer sürücüler, araç ve çevre, içsel gereksinimler, kader ve güvenlik becerileri raporlarken daha düşük algısal-motor beceriler ve daha düşük seviyede otonom araç tercihleri beyan etmişlerdir. Tüm örnekleme bakıldığında, algısal-motor beceriler, araç ve çevre, diğer sürücüler, içsel gereksinimler, otonom araç tercihleri, kader ve güvenlik becerileri için anlamlı cinsiyet farklılığı bulunmuştur.

Erkek sürücüler kadın sürücülere kıyasla daha yüksek seviyelerde otonom araçları tercih etmektedir. Farklı çalışmalarda (Liljamo ve ark., 2018; Payre ve ark., 2014), erkeklerin kadınlara göre daha olumlu tutumlara sahip oldukları ve tam otonom araçları satın alma ve kullanma eğilimlerinin daha yüksek olduğunu bildirilmiştir. Bu farklılığın çeşitli nedenleri olabilir. Öncelikle Hohenberger ve ark. (2016), erkeklerin ve kadınların otonom araçları farklı duygularla ilişkilendirdiklerini bulgulamıştır. Özellikle kadınlar için kaygı ve otonom araçlar arasındaki ilişki, keyif ve otonom araçlar arasındaki ilişkiden daha güçlüdür. Buna karşılık, erkekler ise otonom araçları kaygıdansa keyif alma ile ilişkilendirmektedir.

Trafik iklimi boyutlarında cinsiyet farklılığı sadece içsel gereksinimler boyutu için bulunmuştur. Çin'deki sürücülere benzer şekilde (Üzümcüoğlu Zihni, 2018), hem Türkiye'deki hem de İsveç'teki kadın sürücüler trafik sistemini kendi ülkelerinde hemcinslerine kıyasla içsel gereksinimler açısından daha yüksek değerlendirmiştir. Buradaki en önemli noktalardan biri, trafik ikliminin dışsal duygu talepleri ve işlevsellik boyutları sürücülerin dışarıdaki sürücüleri ve trafik ortamını değerlendirdikleri boyutlarken içsel duygu talepleri sürücülerin aynı zamanda kendilerini de değerlendirdikleri boyuttur (Gehlert ve ark., 2014). Bu nedenle diğer iki boyutta anlamlı farklılık çıkmaması sürücülerin cinsiyetten bağımsız bir şekilde trafik ikliminin bu boyutlarını aynı değerlendirdiğini göstermektedir. Ancak, cinsiyet temelli düşündüğümüzde her iki ülkedeki kadın sürücüler trafik ortamının kendilerinden daha çok beceri beklediğini raporlamıştır. Bunun arkasında genel olarak erkek ve kadın sürücülerin becerilerinin farklı algılanması (Pravossoudovitch ve ark., 2015) ve beyana dayalı sürüş becerilerinde görülen cinsiyet farklılıkları (Özkan ve Lajunen, 2006; Öztürk ve ark., 2018) gibi birçok neden olabilir.

Trafik kontrol odağı boyutları açısından cinsiyet farklılığı araç ve çevre, kader ve diğer sürücüler boyutları için bulunmuştur. Kadın sürücüler bu boyutlarda erkek sürücülerden daha yüksek değerler raporlamıştır. Benzer şekilde Özkan ve Lajunen (2005) de diğer sürücülerin, araç ve çevrenin kadınlarda daha yüksek olduğunu göstermiştir. Buna ek olarak, Sun ve ark. (2020), erkek sürücülerin aksine, kadın sürücülerin diğer sürücüler, araç ve çevre ve kader için daha güçlü atıf yaptığını bulgulamıştır. Bulgular ışığında genel olarak, kadın sürücülerin erkek sürücülere göre daha güçlü bir dış trafik kontrol odağına sahip oldukları söylenebilir.

Farklı çalışmalara benzer şekilde (Özkan ve Lajunen, 2006; Xu ve ark., 2018b), her iki ülkede de, erkek sürücüler, kadın sürücülere göre daha güçlü algısal-motor beceriler raporlamıştır. Öte yandan, Türkiye'den farklı olarak İsveç'teki kadın sürücüler, erkek sürücülere göre daha güçlü güvenlik becerileri belirtmişlerdir. Bulgular toplam örneklemde, kadın sürücülerin erkek sürücülere göre daha güçlü güvenlik becerileri gösterdiği önceki çalışmaları desteklemektedir (Özkan ve Lajunen, 2006; Xu ve ark., 2018b).

Ülke farklılığına ilişkin bulgulara bakıldığında ise algısal-motor beceriler hariç tüm değişkenlerde anlamlı ülke farklılığı bulunmuştur. Türkiye'deki sürücüler daha yüksek dışsal duygu talepleri, içsel gereksinimler, araç ve çevre, kendi becerileri, diğer sürücüler, kendi davranışları ve güvenlik becerileri raporlarken aynı zamanda daha yüksek otonom araç seviyelerini tercih etmektedir. Buna karşılık, İsveç'teki sürücüler ise daha yüksek işlevsellik ve kader raporlamıştır. Kaye ve ark. (2020) ve Schoettle ve Sivak (2014), sürücülerin otomasyon tercihlerinde ülkeler arasında farklılıklar raporlamıştır. Bu çalışmada da, Türkiye'deki sürücüler İsveç'teki sürücülere göre daha yüksek düzeyde otomasyonu tercih etmektedir.

En güçlü ülke farklılıkları trafik iklimi boyutları için bulunmuştur. Gehlert ve ark. (2014) güvenli bir trafik sisteminin duygusal olarak daha az talepkar ve daha işlevsel olacağını tartışmıştır. Türkiye'nin trafik sistemi hem duygusal hem de beceriler açısından daha talepkar görülürken, İsveç'in trafik sistemi daha az talepkar ve daha işlevsel bir trafik sistemi olarak değerlendirilmektedir. İki ülkenin trafik iklimi arasındaki farklılıklara dayanarak, İsveç'in Türkiye'den daha güvenli ve daha az riskli bir trafik sistemine sahip olduğu söylenebilir. Trafik kontrol odağı faktörleri açısından Türkiye'deki sürücüler kader boyutu hariç diğer tüm boyutlarda anlamlı olarak yüksek değerler raporlamıştır. Sadece kader boyutunda İsveç'teki sürücüler daha yüksek değer raporlamıştır. Genel anlamda hem dışsal hem de içsel boyutlara atfın Türkiye'de daha yüksek olmasının nedeni Türkiye'de sürücülerin İsveç'teki sürücülere göre daha yüksek seviyede trafik kazası deneyimlemesi olabilir.

Wallén Warner ve ark. (2010) tarafından on yıl önce Türkiye ve İsveç arasındaki sürüş becerileri kıyaslamalarına paralel bir şekilde, Türkiye'deki sürücüler daha yüksek güvenlik becerileri raporlarken algısal-motor beceriler açısından bu farklılık anlamlı bulunmamıştır. Genel olarak, Türkiye'deki sürücüler kendilerini güvenlik becerileri açısından daha becerikli algılıyor olabilirler. Ancak, özellikle Türkiye örnekleminin genç olması da bu farklılığa neden oluyor olabilir. Örneğin, Martinussen ve ark. (2017)

tarafından da belirtildiği gibi genç erkeklerin raporladıkları sürüş becerileri ile gerçek performansları tutarlılık göstermemektedir.

Ülke ve cinsiyetin etkileşim etkisi sadece kader ve diğer sürücüler boyutları için anlamlı bulunmuştur. Kader boyutu için İsveç'teki kadın ve erkek sürücüler Türkiye'deki hemcinslerinden daha yüksek değerler raporlamışlardır. Măirean ve ark. (2017) çalışmasına benzer bir şekilde, İsveç'te kadınlar erkeklerden daha yüksek kader değeri göstermiştir. Türkiye'deki farklılık için Özkan ve Lajunen (2005) çalışmasına paralel olarak kader boyutu açısından Türkiye'de cinsiyet farklılığı bulgulamamıştır. Diğer sürücüler için bakıldığında ise İsveç'teki kadın sürücüler erkek sürücülerden daha yüksek diğer sürücüler boyutuna atıf yaparken Türkiye'de bu fark anlamlı değildir. Yine iki ülkede kadın sürücüler için farklılık anlamlı değilken erkek sürücüler Türkiye'de diğer sürücülere İsveç'teki erkek sürücülerden daha fazla atıf yapmaktadır.

Sürücülerin Otonom Araç Tercihlerine Etki Eden Faktörler

Otonom araç tercihlerinde trafik iklimi, trafik kontrol odağı ve sürüş becerilerinin rollerinin araştırılması için aşamalı regresyon ve düzenleyici etki analizleri yapılmıştır. Bu analizlerde birinci aşamada yaş, cinsiyet ve son bir yılda kat edilen kilometre kontrol değişkeni olarak eklenmiştir. Demografik değişkenlerin istatistiki etkisini kontrol ettikten sonra trafik iklimi, trafik kontrol odağı ve sürüş becerileri faktörlerinin ortalama değerleri ayrı ayrı modele dahil edilmiştir. Bu üç analiz Türkiye ve İsveç için tekrarlanmıştır.

Türkiye örnekleminde trafik iklimi, trafik kontrol odağı ve sürüş becerileri için test edilen modeller anlamlı bulunmuştur. Demografik değişkenlerde kadın sürücüler ve son bir yılda daha fazla kilometre kat eden sürücüler daha düşük seviyelerde otonom araçları tercih etmiştir. Buna ek olarak, ikinci aşamada işlevsellik ve güvenlik becerileri pozitif ilişki gösterirken algısal-motor beceriler negatif ilişki göstermiştir. Türkiye'deki trafik sistemini daha işlevsel algılayan sürücüler, güvenlik becerileri yüksek sürücüler ve algısal-motor becerileri düşük sürücüler daha yüksek seviyelerdeki otonom araçları tercih etmektedir.

İsveç örneklemine ilişkin modellerde trafik iklimi anlamlı değilken trafik kontrol odağı ve sürüş becerileri için anlamlı etki bulunmuştur. Demografik değişkenler açısından kadınların daha düşük otonom seviyede araçlar tercih ettiği görülmüştür. İkinci aşamada ise, otonom araç tercihleri ile kendi becerileri pozitif ilişki gösterirken diğer sürücüler ve algısal-motor beceriler negatif ilişki göstermektedir. Kazaları kendi becerilerine daha çok atfeden sürücüler, kazaları daha az diğer sürücülere atfeden sürücüler ve algısal-motor becerilerini düşük raporlayan sürücüler daha yüksek seviyelerde otonom araçları tercih etmektedir.

Trafik iklimi faktörlerinde, sadece Türkiye'de trafik sisteminin işlevselliğini daha yüksek algılayan sürücüler daha yüksek otomasyon seviyelerini tercih etmişlerdir. İşlevsellik, işlevsel bir sistemin özellikleri ve gereksinimleri ile ilgilidir (Gehlert ve ark., 2014). Trafik sistemini ileri derecede işlevsel olarak algılayan sürücüler, otonom araçların potansiyel teknolojik bileşenlerini ve işlevlerini göz önünde bulundurarak daha yüksek seviyelerde otomasyonu tercih ediyor olabilir.

Beklentilerimizin aksine, trafik kontrol odağının boyutlarının büyük bir çoğunluğu otonom araç tercihleri ile anlamlı bir ilişki göstermemiştir. Aşamalı regresyon analizlerinde Türkiye'de tüm boyutlar anlamsız ilişki gösterirken, İsveç'te, sadece kendi becerileri pozitif ve diğer sürücüler negatif ilişki göstermiştir. Payre ve ark. (2014)'nın satın alma niyeti ve tam otonom araçların kabulü ile içsel kontrol odağı arasındaki pozitif ilişkiye benzer şekilde bu çalışmada da İsveç'te trafik kazalarını kendi becerilerine atfeden sürücüler daha yüksek seviyelerde otonom araçları tercih etmiştir. Ayrıca, kazaları diğer sürücülere atfeden sürücüler daha düşük otonom seviyelerini tercih etmiştir. Burada önemli olan etken trafik kazalarını daha çok diğer sürücülere atfeden sürücülerin kendi araçlarının kontrolünü elinde tutma isteği ve olabilir. Örneğin, Liljamo ve ark. (2018) sürücülerin çoğunun araçlarının kontrolünü bilgisayar sistemine bıraktıklarında stresli hissedeceğini bulmuştur.

Sürüş becerilerinin sürücülerin otonom araç tercihlerine olan etkisi incelendiğinde iki temel sonuç dikkat çekmektedir. İlk olarak iki ülkede de algısal-motor becerileri yüksek olan sürücüler otonom araçlarda daha düşük seviyeleri tercih etmektedir. Lajunen ve Summala (1995) tarafından da belirtildiği gibi algısal-motor beceriler trafikte teknik becerileri ve kabiliyetleri içermektedir. Kendilerini bu açıdan iyi gören sürücüler daha düşük seviyedeki otonom araçları farklı nedenlerden dolayı tercih etmiyor olabilirler. İlk olarak otomasyon seviyesi arttıkça sürücülerin trafikte daha az teknik beceri gerektiren iş yapacak olması olabilir. Bunun aksine, daha yüksek otomasyon seviyelerine sahip araçları kullanmanın, sürücülerin algısal-motor becerileriyle yakından ilgili bazı teknik görevleri otonom araç sistemine aktarabilecekleri anlamına geldiği öne sürülebilir. Bu beceri aktarımı, araç kullanma ile ilgili görevlerin sürücüler üzerindeki yükünü hafifletebilir.

İkincisi ise algısal-motor becerilerin aksine güvenlik becerilerinde sadece Türkiye'de anlamlı bir etki bulunmuştur. Bu etkiye göre güvenlik becerilerini yüksek algılayan sürücüler aynı zamanda daha üst seviyelerde otonom araçları tercih etmektedir. Buna ek olarak, son modelde güvenlik becerileri-dışsal duygu talepleri-ülke üçlü etkileşimi İsveç'te ise sadece trafik sistemi dışsal duygu talepler açısından yüksek algılandığında güvenlik becerileri otonom araç tercihleri ile pozitif ilişki göstermiştir. Burada, özellikle otonom araçların güvenlik ile ilişkisinin ön plana çıktığı düşünülebilir. Örneğin, Hagl ve Kouabenan (2020) ileri sürüş asistanı sistemlerini kullanan sürücülerde riskleri kontrol altında tuttuklarına dair hislerin daha yüksek olduğu ve kendi riskli davranışlarından dolayı kazaya karışma olasılıklarını daha düşük algılandığını bulgulamıştır. Ayrıca, İsveç'te dışsal duygu taleplerinin yüksek olduğu durumlarda güvenlik becerilerinin etkisinin anlamlı olması da dışsal duygu taleplerinin tetikleyici rolüne işaret etmektedir.

İsveç'teki güvenlik becerileri ve dışsal duygu talepleri arasındaki etkileşime benzer şekilde, araç ve çevre-dışsal duygu talepleri-ülke üçlü etkileşimi, İsveç'te, trafik sistemi duygusal olarak yüksek derecede talepkâr olarak algılandığında, araç ve çevrenin otonom araç tercihleri ile pozitif bir şekilde ilişkili olduğunu göstermiştir. Özkan ve Lajunen (2005), trafik sisteminin yüksek araç ve çevre veya dış trafik kontrol odağı olan sürücüler tarafından riskli ve zorlu olarak algılanabileceğini tartışmıştır. Benzer şekilde, artan dışsal duygu talepleri birlikte sürücüler, diğer sürücülerin sürücü davranışlarını daha riskli olarak algılamaktadır (Gehlert ve ark., 2014). Genel olarak, duygusal olarak zorlu sürüş ortamında, kazaları araca ve çevre faktörlerine bağlayan sürücülerin daha yüksek otomasyon seviyelerini tercih etme eğiliminde oldukları söylenebilir.

Öte yandan, yine güvenlik becerileri-dışsal duygu talepleri-ülke üçlü etkileşiminde, Türkiye'de güvenlik becerileri, düşük veya orta düzeyde dışsal duygu talepleri altında otomasyon tercihleri ile pozitif bir şekilde ilişkilendirilirken yüksek dışsal duygu taleplerinde bu ilişki kaybolmuştur. Kendi becerileri-işlevsellik-ülke üçlü etkileşiminde, İsveç'te, düşük ve orta düzeydeki işlevsellik ile kendi becerileri ve otomasyon tercihleri arasında pozitif bir ilişki bulunmuştur. Diğer bir deyişle, trafik sistemini işlevsellik açısından düşük veya orta düzeyde algılayan sürücülerin karayolu trafik kazalarının daha yüksek düzeyde kendine atfedilmesi, daha yüksek otomasyon seviyelerine yönelik bir tercihle ilişkilendirilmiştir. Aksine, diğer sürücüler-işlevsellik-ülke üçlü etkileşiminde, İsveç'te yüksek düzeyde işlevsellik için diğer sürücüler ve otomasyon tercihleri arasında negatif bir ilişki bulunmuştur. Diğer sürücülere atıf sadece işlevsellik boyutu yüksek algılandığında otonom araç tercihleriyle negatif ilişkilendirilmiştir. Qu ve ark. (2019), işlevselliğin, otonom araçları kullanma isteği ile pozitif bir korelasyon içindeyken, aynı zamanda insanların otonom mod hakkındaki endişeleri ile de olumlu bir şekilde ilişkili olduğunu bulmuştur. Buna dayanarak, belirli bir işlevsellik noktasından sonra, otonom araçlarla ilgili endişelerin, kendi becerileriyle otonom araç tercihleri arasındaki ilişkiyi etkisiz hale getirebileceği tartışılabilir. Özellikle kazaları diğer sürücülere bağlayan sürücüler için, daha yüksek işlevsellik otonom araçlarla ilgili endişeleri vurgulayabilir.

Kısıtlılıklar ve Gelecek Çalışmalar için Öneriler

Bulgular ve önerilerin yanı sıra, sonuçları yorumlarken ve gelecekteki çalışmaları tasarlarken dikkate alınması gereken birkaç sınırlılık bulunmaktadır. Mevcut çalışmanın bulguları hem bağımsız değişkenler hem de otonom araç tercihleri açısından büyük ülke ve cinsiyet farklılıkları ve otonom araçlarla ilgili önemli ilişkiler ortaya koysa da, nihai etkileşim modeli nispeten küçük varyans açıklamaktadır. Bu anlamda mevcut çalışmanın bulgularında bu durum dikkate alınarak yorumlanmalıdır. Mevcut çalışmanın kısıtlılıklarından biri de, tüm ölçümlerin beyana dayalı yöntemlerle toplanmış olmasıdır. af Wåhlberg ve ark. (2011; 2015), beyana dayalı ölçümlerde ortak yöntem varyansı, yayın yanlılığı ve sosyal istenirlik gibi birkaç kısıtın olabileceğini tartışmıştır.

Ayrıca, Türkiye ile İsveç arasındaki farklılıklar, iki örneğin demografik özelliklerinden de etkilenebilir. Daha önce de belirtildiği gibi, Türkiye'deki sürücüler İsveç'teki sürücülere göre daha fazla aktif ve pasif kazalar yaşamıştır. Buna rağmen daha genç ve daha az sürüş deneyimine sahiptirler. Genel olarak, İsveç'ten gelen sürücülerin nispeten daha deneyimli ve daha güvenli olduğu (kaza geçmişi açısından) önerilebilir. Ayrıca, örneklemlerin üniversite öğrencilerinden oluşması bulguların genellenebilirliğini kısıtlamaktadır. Bu açıdan farklı ülkelerde görece benzer ve/veya farklı gruplarla çalışmanın tekrarlanması bulguların güvenilirliği ve geçerliliği için önem taşımaktadır.

Gelecekteki Araştırmalar için Çıkarımlar ve Öneriler

Genel olarak, mevcut çalışmanın sonuçları, otonom araçlarda (Kaye ve ark., 2020; Schoettle ve Sivak, 2014), trafik ikliminde (Üzümcüoğlu Zihni, 2018), sürüş becerilerinde (Wallén Warner ve ark., 2013) ülkeler arası farklılıkları raporlayan önceki çalışmaları desteklemektedir. Noy ve ark. (2018) trafik sistemine otonom araçların dahil edilmesinin trafikle ilgili birçok değişkende radikal tanım değişikliklerine neden olabileceğinin belirtmiştir. Mevcut çalışmada trafik iklimi ile otonom araç tercihleri arasındaki ilişkilerin büyük çoğunluğu anlamlı olmasa da, farklı otomasyon seviyelerine sahip araçların dahil edilmesinin ardından teoride özellikle trafik güvenliği ve iklimi çalışmaları için önemli bulgular sağlayabileceği düşünülmektedir. Chan (2017) tarafından tartışıldığı gibi, otonom sürüş sistemleriyle daha verimli, etkili ve daha az talepkâr bir trafik ortamı gözlemlenebilir. Benzer şekilde, Noy ve ark. (2018) otonom sürüşün potansiyel faydalarını da tartışmıştır. Örneğin, düşük bir otomasyon seviyesi olan sürücü yardım sistemlerinin ortaya çıkmasıyla bile, sürüşün daha rahat ve daha güvenli olması beklenmektedir (Hagl ve Kouabenan, 2020).

Tartışma bölümünün önceki kısımlarında daha detaylı bir şekilde ele alındığı gibi yüksek seviyedeki otonom araçları sürücüler beceriler açısından nasıl algılıyor ve bu araçları kendi becerileri ile değerlendirdiklerinde ne gibi çıkarımlarda bulunuyorlar şeklinde konular bu ilişkinin daha detaylı incelenmesi için önem taşımaktadır. Aynı zamanda, farklı seviyelerde otomasyon özellikleri olan araçları çalıştırmak için gereken beceriler göz önünde bulundurulduğunda (Navarro, 2019), kullanılan araçtan farklı teknik gereksinimler geldiğinde farklı otomasyon seviyeleri için Sürüş Becerileri Ölçeği'nin madde içeriğini gözden geçirmek önemli olabilir. Örneğin, “aracı başarılı bir şekilde devralıp kontrol etmek” ve “sistem aracı kontrol ederken çevreyi olası risklere karşı izlemeye devam etmek”, belirli bir otomasyon seviyesinden sonra araçlar için temel beceriler olabilir.

Ek olarak, otonom araçlara yönelik olumlu tutumları teşvik etmek için eğitim kampanyaları kullanılabilir (Kaye ve ark., 2020). Otonom araçları tanıtırken olumlu duyguları teşvik etme ve olumsuz duyguları azaltma tartışmasına benzer şekilde (Hohenberger ve ark., 2016), sürüş becerisi bulguları dikkate alınırsa, otonom araçlarla ilgili reklamlarda, genel olarak teknik becerilere ihtiyaç duyulmayabileceğini vurgulayan mesajlar, daha yüksek algısal-motor becerilere sahip sürücüler üzerinde olumsuz bir etkiye sahip olabilir. Bunun aksine, algısal-motor becerilere ve herhangi bir güvenlik biçimine yönelik potansiyel katkılara daha fazla vurgu yapılması, sürücülerin daha olumlu yönelimiyle sonuçlanabilir.

Sonuç

Sosyal bilimler, otonom araçların güvenlikten verilere kadar farklı yönlerinde çeşitli roller oynayabilir (Cohen ve ark., 2020). Ashkrof ve ark. (2019), yolcuların demografik özellikleri, tutumları ve seyahat amacı gibi farklı faktörlerin, otonom araçların benimsenmesini etkilediğini tartışmıştır. Benzer şekilde, bu çalışmada, sürücü ile ilgili farklı değişkenlerin ve trafik sisteminin özelliklerinin, sürücülerin otonom araç seçimleriyle ilişkisi incelenmiştir. Genel olarak, Türkiye ve İsveç'ten alınan örnekler hakkında sekiz önemli bulgu tartışılabilir.

1. Karayolu güvenliği istatistiklerine benzer şekilde (WHO, 2018), Türkiye ve İsveç’te, otonom araç tercihleri de dahil olmak üzere karayolu güvenliğiyle ilgili ölçümlerde önemli farklılıklar bulunmuştur.

2. Her iki ülkedeki sürücülerin çoğu, otomasyonu daha düşük olan veya hiç olmayan araçları tercih etmiştir.

3. Cinsiyet ve ülke farklılıkları araç tercihleri açısından önemli bir rol oynamaktadır. Genel anlamda, kadın sürücülere kıyasla erkek sürücüler ve İsveç'teki sürücülere kıyasla Türkiye'deki sürücüler daha yüksek düzeyde otomasyonu tercih etme eğilimindedir.

4. Otonom araç tercihleriyle güvenlik becerileri, kendi becerileri, işlevsellik pozitif ve algısal-motor beceriler ve diğer sürücüler negatif yönde ilişkilidir.

5. Trafik sisteminin dışsal duygu talepleri ve işlevselliği, farklı bireysel faktörler ve otonom araç tercihleri ilişkisinde düzenleyici bir rol oynayabilir.

6. Genel olarak, sürücülerin açık veya örtük şekilde sürüş becerileri, olası kaza nedenleri, trafik ortamı algısı gibi farklı faktörlerden etkilenerek araç tercihlerini belirlediğini önerilebilir.

7. Bulgular, özellikle otonom araçlar ile ilgili araştırma ve pazarlama alanlarında çalışanlar için bazı önemli noktalar sunmaktadır.

8. Otonom araçların gelecekteki kullanımında, farklı bireysel ve ülke düzeyindeki faktörler önemli roller oynayabilir.

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