Psychometric Properties of the Driving Behavior Survey among Iranian Drivers

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ABSTRACT

Objective: There are not enough good instruments for assessing driving behavior in Iran. This study aimed to investigate factor structure, convergent and divergent validity, and reliability of driving behavior survey (DBS).

Methods: The study method is descriptive and survey. Participants comprised 147 Sample selected by convenient method. Iranian drivers who completed DBS, Manchester driver behavior questionnaire, trait anxiety scale, and trait anger scale.

Results: findings showed that 3 factors of DBS could explain 39% of total variance. Anxiety-based performance deficits, exaggerated safety and caution behaviors, and hostility/aggressive behaviors were 3 factors of DBS. There were convergent correlations between DBS subscales and common driving mistakes and traffic rules violations. Cronbach's alpha was estimated 0.77, 0.65 and 0.70 for subscales.

Conclusion: Driving behavior survey has convincing psychometrical features. It could be used in general population and clinical settings for investigating anxious drivers.

1. Introduction

Traffic accidents have been regarded as one of the most catastrophic phenomena in recent years. Car accidents impose a tremendous cost on societies. According to global estimates, road accident is the second main cause of death in the world and 1.3 million people die on the roads annually (WHO, 2009). Furthermore, survivors of car accidents are more susceptible to mental disorders, especially post traumatic stress disorder (PTSD) and major depressive disorder (Hurska, Irish, Pacella, Sledjeski, Delahanty, 2014; Alghnam, Wegener, Bhalla, Colantuoni, Castillo, 2015). Mortality rates of road accidents in Iran have been reported at 11% to 20% in the last decade (Lankarani, Sarikhani, Heydari, Joulaei, and Mahrlouei, et al., 2014). Road traffic accidents were identified as the third leading cause of mortality in Iran (Bhalla, Naghavi, Shahraz, Bartels, and Murray, 2009). Mechanical properties of roads and automobile engineering could decrease the probability of road crashes, but human factors still have remained one of the most significant factors in etiology of road accidents. Findings of some recent meta-analyses showed that human factors, including driving skills and driver's styles have a very important role in predicting road accidents (Roshandel, Zheng, Washington, 2015). In other words, traits of personality, driver's attitudes, driver's mental, and cognitive abilities influence driving behavior and consequently road accidents. Previous studies have demonstrated that different drivers' behaviors such as cognitive errors and deliberate violations of traffic

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rules could predict and discriminate drivers with high rate of accidents from ones with low rate (Clarke, Robertson, 2005; Nesbit, Conger, 2012).

One of the main psychological factors that could contribute to road traffic accidents is anxiety. Previous studies have shown that individuals with higher levels of anxiety are more prone to engage in car accidents (Dula, Adams, Miesner, and Leonard, 2010), and anxious style in driving is associated with low consciousness and higher level of neuroticism (Taubman-Ben-Ari, Yehiel, 2012; Poó, Ledesma, 2013). Anxiety in the traffic psychology literature has only been discussed with resect to specific phobia of driving and avoidance of driving in highways; however, many people with high level of anxiety may not avoid driving. In other words, anxiety not only do express in full blown psychological disorders such as specific phobia or PTSD, but also may express itself in people with seemingly ordinary functioning. Anxious driving has been operationally defined as any increase, decrease, or disorganization in performing driving skills or adopting specific behavior due to experience of different levels of anxiety (Clapp, Olsen, Beck, Paylo, Grant, and Gudmundsdottir et al., 2011). Anxious drivers who continue driving against their inner feelings would express them by adopting different kinds of behaviors. Any organism may show 3 defensive behavioral strategies of flight, freeze, and fight against anxiety (Gray, 1987); so experience of anxiety during driving would be expressed through these main behaviors. Therefore in the context of driving anxiety, we could expect that some people with high levels of anxiety express their feelings by avoidance, others by aggressive behaviors, and some others may got shocked during driving and loose their control on driving performance (Taylor, Paki, 2008).

In a novice conceptualization, anxiety-related behaviors have been classified to 1) anxiety-based performance deficits, 2) exaggerated safety/caution behavior, and 3) hostile/aggressive behaviors (Clapp, Olsen, Beck, Paylo, Grant, and Gudmundsdottir et al., 2011). This new classification has been proposed as an instrument for evaluating behavioral manifestation of anxiety in driving. This new device, called driving behavior survey (DBS) has some advantages over other driving behavior assessment tools. Firstly, most of the previous instruments had been constructed to pool cognitive errors or to evaluate frequency and types of violations during driving. Secondly, almost all scales in road and traffic literature had been related to anger, but few devices for evaluating anxiety and anxiety-related behaviors. Thirdly, this scale has been constructed not only for using in clinical settings, but also is a good indicator of driver ability to steer automobile.

This new instrument has been validated in some countries and in different settings (Baker, Litwack, Clapp, Beck, Sloan, 2014; Clapp, Olsen, Beck, Paylo, Grant, and Gudmundsdottir et al., 2011). Preliminary findings confirmed the construct validity and internal consistency of this device (Clapp, Olsen, Beck, Paylo, Grant, and Gudmundsdottir et al., 2011; Clapp, Baker, Litwack, Sloan, and Beck, 2014). However, there was little information about the relationship between anxiety-related behaviors and common errors in driving and violations of traffic regulations. Given high percentages of mortality rates due to automobile accidents in middle-income countries such as Iran, it is necessary to apply new screening instruments for identifying drivers susceptible to traffic accident injuries. So this study aimed to evaluate factor structure, reliability, and convergent validity of DBS and to investigate the relationship between anxiety-related behaviors and some well-known errors and violation behaviors during motor vehicle driving.

2. Methods

It was a descriptive and survey study. The Population was drivers in a Kharazmi university including students and taxi drivers Participants were selected by convenience sampling method. Inclusion criteria require participants to be at least 20 years old, have a driver's license, and drive a car at least one day per week. Some of the subjects enrolled in the study through web-based survey on driving behaviors and others completed self-report questionnaires. At the final stage of sampling, 147 individuals met all criteria and their responses were used for statistical analysis. This study conducted in 2015.

By this validation study, we try to address psychometrical aspects of a new instrument for evaluating driving anxiety. Among existing instruments, DBS was selected and translated into Persian. Then, the translation was sent to a psychiatrist and a psychologist to check the compatibility of the translation with the original English text. Having received their comments, the translation was revised. Next, we evaluated internal consistency, factor structure, convergent validity, and divergent validity of DBS.

This is a 21-items measure, scored in 7-point Likert-type scale itemes are rated with 7-point Likert-type scale, in which 1=never, 2=very infrequently, 3=infrequently, 4=sometimes, 5=frequently, 6=very frequently, and 7=always. The higher scores indicate greater frequency of anxious-related behaviors. Minimum score were 21 and maximum score could be 147 This measure was first developed to evaluate anxiety-related behaviors. This measure contains 3 separate factors, including exaggerated safety/caution behaviors, anxiety-based performance deficits, and hostile/aggressive driving behaviors. The first subscale is indicative of a driving style with high levels of anxiety, expressed

by exaggerated safety behaviors like distancing from other motor vehicles during driving in highways. The second subscale was deemed to sample performance breakdowns due to high anxiety like loss of control during driving or difficulty in staying in correct lane. The third subscale is consisted of impulsive and aggressive behaviors (due to high level of anxiety) like honking the horn or hitting other drivers' cars (Clapp, Olsen, Beck, Paylo, Grant, and Gudmundsdottir et al., 2011).

DBS was validated in a group of undergraduate students and individuals with a history of motor vehicle crashes and diagnosis of PTSD (Clapp, Olsen, Beck, Paylo, Grant, and Gudmundsdottir et al., 2011; Clapp, Baker, Litwack, Sloan, and Beck, 2014). In these studies, 3 proposed factorial structures of this measure were confirmed, and internal consistency of these subscales were estimated between 0.77 and 0.86. Also, findings of test-retest reliability of DBS scales ranged from 0.61 to 0.89 (Clapp, Olsen, Beck, Paylo, Grant, and Gudmundsdottir et al., 2011).

This is the most widely-used measure in the traffic psychology literature and has been validated in many countries like Iran (Oreyzi, Haghayegh, 2009). It consists of 50 items with a 4-point Likert-type scoring system in which 0=never, 1=not often, 2=sometimes, 3=frequently, 4=othen time, 5=always. Confirmatory factor analysis supported the 4 suggested factor solutions for this instrument. Iranian version of Manchester driver behavior questionnaire (MDBQ) consists of unintentional violation, deliberate violation, slips, and errors. Unintentional violations include behaviors like unconscious increase of the car speed or hitting a passenger due to mind wandering (Reason, Manstead, Stradling, Baxter, and Campbell, 1990).

Deliberate violation is indicative of overt transgression of traffic laws and insulting other drivers; for example, tailgating other drivers or show aggressive gestures and yelling at them (Reason, Manstead, Stradling, Baxter, and Campbell, 1990). Slips include cognitive processing shortages, which leads to aberrant driving behaviors such as forgetting destination during driving or forgetting the place where the car was parked (Reason, Manstead, Stradling, Baxter, and Campbell, 1990). Errors are defined as inability to reach intended behaviors during driving such as misjudging the speed of another vehicle when overtaking (Reason, Manstead, Stradling, Baxter, and Campbell, 1990). Results of evaluating reliability of MDBQ indicated that all subscales had good consistency ranged between 0.78 and .091 (Oreyzi, Haghayegh, 2009).

This measure consists of 20 statements evaluating the experience of anxiety in the forms of agitation, sadness, indecisiveness, low concentration, and life dissatisfaction. Questions were extracted from trait anxiety items of Speliberger state-trait anxiety inventory (Speilberger, 1983). Respondents were asked to determine how often they experience anxiety. Responses are rated with 4-point Likert-type scale, in which 1=not at all, 2=somewhat, 3=moderately so, and 4=very much. Internal consistency of this scale was 0.9 and test-retest reliability of this scale among undergraduate students was 0.86 (Mahram, 1994). Furthermore, it is demonstrated that this scale could predict risky driving style (Pourabdian, Azmoon, 2013).

This inventory is used to assess internal disposition to express anger and evaluates personal vulnerability toward trait anger. It was extracted from trait form of Speilberger state-trait anger expression inventory (Forgays, Forgays, and Speilberger, 1997). Statements are scored in a 4-point Likert-type scale like trait anxiety scale. Internal consistency of this scale was calculated 0.85 in an Iranian sample (Khodayarifar, Lavasani, Akbari, and Lyaghat, 2007); it has a significant association with road rage and automobile crashes (Sullman, Stephens, and Yong, 2015). Data ware analyzed by confirmatory factor analysis, Pearson correlation, chi-square and coefficient alph. We used spss-16 for conducting statistical analysis.

3. Results

A total of 103 (70%) males and 44 (30%) females participated in this study. Their gender, age distribution, educational levels, marital status and job are presented in Table 1. There were significant differences between groups with regard to age (Chi-square=89.08, P>0.01), educational levels (Chi-square=23.68, P>0.01) and marital status (Chi-square=9.31, P>0.05). Among participants, 23 were professional drivers as taxi drivers and 124 were ordinary people whose jobs were not related to driving. Normality of data of driving behavior survey were evaluated by running kolmogorov-smirnov test (z=0.855, p=0.458).

Factor structure and construct validity of DBS was examined by running principal component analysis with varimax rotation. Results of the factor analysis revealed 7 factors with eigenvalues greater than 1, which explained 63% of the total variance. However, the scree plot (Figure 1) suggests 3-, 4-, or 5-factor solution. All options were examined to find optimal factor solution. Furthermore, examining items loading on 4 and 5 factor solutions revealed no items with loading greater than 0.3. So, in accordance with the developers of DBS, we selected 3-factor solution for factor structure of DBS. Results of KMO and Bartlett test of sphericity indicated that the distribution of data has appropriate characteristics to run factor analysis (KM0=0.733,

Table 1. Demographic characteristics of the participants.

Variables	Frequency (%)
Gender	
Male	103(70.1)
Female	44(29.9)
Education degree	
Secondary school	13(8.8)
Diploma	28(19)
BA	51(34.7)
MA	38(25.9)
PhD	17(11.6)
Marital status	
Single	92(62.6)
Married	55(37.4)
Occupation	
Non-driver	123(83.7)
Taxi driver	23(15.6)
Age group, y	
18-25	23(15.6)
25-35	59(40.1)
35-50	53(36.1)
>50	12(8.2)

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Chi-square= 774.057, P<00.1). Eigenvalues and explained variance of components are shown in Table 2.

The first component comprised items 3, 8, 11, 12, 13, and 16. The second component encompasses items 1, 4, 5, 6, 9, 14, 15, and 21. And third component consisted of items 2, 7, 10, 17, and 18. Item 19 and 20 were not load on any of the factors and have been omitted. Table 3 presents loading of items in rotated component matrix for 3-factor solution.

The Cronbach's alpha reliability was calculated for whole and each of the DBS subscales. Cronbach's alpha for the entire scale was 0.68 and for the first factor was 0.77. cronbach's alpha for the second factor was 0.70, and for the third factor was 0.65. Table 4 shows zero order correlations between DBS subscales of trait anxiety, trait anger, and different kinds of driving errors and traffic violation. It shows that total score of DBS is associated with unintentional violation during driving. There was also a significant correlation between hostility and aggressive subscale of DBS and trait anger (r=0.31, P<0.001). Association between trait anxiety and anxiety-based performance was significant too (r=0.16, P<0.05), whereas there was no significant association of exaggerated safety/caution behavior subscale with trait anxiety or trait anger. There were significant association between first subscale of DBS (anxiety-based performance) and other variables including errors, violations and trait anger and trait anxiety. Whereas, this pattern of association were not observed among other subscales of DBS and MBDQ subscales, trait anxiety and trait anger.

4. Discussion

This study aimed to investigate factor structure and reliability of DBS measure. Results of confirmatory factor analysis indicated a 3-factor solution as an optimal fac-

Table 2. Eigenvalues and explained variance of 3-factor solution of driving behavior survey.

Component	Eigenvalues	Total variance	Cumulative variance
1	3.288	15.65	15.65
2	2.844	13.542	29.198
3	2.176	10.363	39.561

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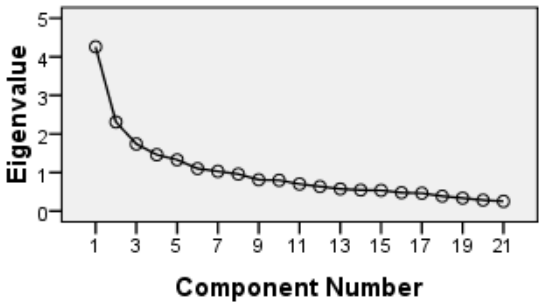

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Figure 1. Eigenvalues on the scree plot of DBS.

tor structure for DBS. This result is consistent with other studies conducted for assessing factor structure of DBS among undergraduate students and individuals with a history of road accidents (Clapp, Olsen, Beck, Paylo, Grant, and Gudmundsdottir et al., 2011). Consistent with DBS original factor structure, the items extracted in the first factor were indicator of an exaggerated safety and caution driving style. Items loaded on the second factor also revealed the ones related to effects of anxiety on the performance. And items related to third factor seem to appropriately reflect the hostility and aggressive behaviors during driving.

Avoidance which is the behavioral manifestation of anxiety may be transformed into exaggerated safety and caution behaviors in driving. Results of previous studies had also shown a direct relationship between exaggerated safety and caution behaviors and travel avoidance among undergraduate students (Taylor, Sullman, 2009). In DBS, the strongest factor which was representative of driving with anxiety was exaggerated safety and caution behaviors that explained 15% of total variance.

Table 3. Rotated component matrix for 3-factor solution.

Items	Component		
	1	2	3
1. I lose track of where I am going.	0.029	0.586	0.111
2. I yell at the driver/drivers who make me nervous.	0.100	0.168	0.604
3. I slow down when approaching intersections, even when the light is green.	0.333	0.252	0.101
4. I have trouble staying in the correct lane.	0.101	0.628	0.154
5. I drift into other lanes.	0.194	0.586	0.036
6. I forget to make appropriate adjustments in speed.	0.165	0.442	0.001
7. I let the driver who made me nervous know that I am upset.	0.415	0.263	0.480
8. I maintain a large distance between myself and the driver in front of me.	0.825	0.249	0.043
9. I forget where I am driving to.	0.135	0.653	0.139
10. I make gestures to the driver/drivers who made me nervous.	0.104	0.163	0.671
11. I try to put distance between myself and other cars.	0.577	0.122	0.125
12. I maintain my speed in order to calm myself down.	0.748	0.097	0.120
13. I try to stay away from other cars.	0.739	0.013	0.031
14. I have trouble finding the correct lane.	0.411	0.501	0.076
15. I pound on the steering wheel when I am nervous.	0.233	0.319	0.290
16. I decrease my speed until I feel comfortable.	0.700	0.120	0.087
17. I honk my horn at the driver who made me nervous.	0.000	0.057	0.644
18. I try to find ways to let other drivers know that they are making me nervous.	0.015	0.097	0.714
19. During bad weather, I drive more cautiously than other vehicles on the road.	0.221	0.078	0.047
20. I swear/use profanity while I am driving.	0.033	0.292	0.064
21. I have difficulty merging into traffic.	0.084	0.630	0.052

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Table 4. Zero-order correlations among DBS subscales, anxiety, anger, and MDBQ subscales.

	1	2	3	4	5	6	7	8	9	10
1. ABPD	1	-0.26**	0.25**	0.39**	0.24**	0.29**	0.33**	0.27**	0.16*	0.16*
2. ESCB	-0.26**	1	-0.71	0.63**	0.053	-0.12	-0.14	0.009	-0.71	-0.95
3. HAB	0.25**	-0.71	1	0.53**	0.12	0.22**	0.15	0.048	0.066	0.31**
4. Total DBS	0.39**	0.63**	0.53**	1	0.25**	0.14	0.13	0.14	0.07	0.15
5. Unintentional violation	0.24**	0.053	0.12	0.25**	1	0.44**	0.62**	0.44**	0.326	0.31**
6. Intentianla violation	0.29**	-0.12	0.22**	0.14	0.44**	1	0.56**	0.44**	0.35**	0.39**
7. Lapse	0.33**	-0.14	0.15	0.13	0.62**	0.56**	1	0.71**	0.33**	0.35**
8. Error	0.27**	0.009	0.048	0.14	0.448**	0.446**	0.71**	1	0.33**	0.35**
9. Anxity	0.167*	-0.71	0.066	0.073	0.32**	0.359**	0.336**	0.242**	1	0.476**
10. Anger	0.166*	-0.095	0.311**	0.15	0.31**	0.390**	0.35**	0.255**	0.476**	1

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Abbreviations: ABPD=Anxiety-based performance deficit, ECSB=Exaggerated safety/caution behavior, HAB=Hostility aggressive behavior; DBS= Driver behavior survey.

* P<0.05. ** P<0.01.

The second factor was related to anxiety-based performance. This kind of anxiety may relate to skill shortage of anxious drivers that leads to remarkable and frequent mistakes and traffic rule violations. Anxiety during driving may decrease driver's ability to control automobile and their performance. So, including anxiety-based performance in DBS was a good choice. This subscale was the best indicative factor for driving with anxiety. This finding supported previous studies which highlighted the importance of anxiety-based performance deficits as the main problem of anxious driving (Clapp, Olsen, Beck, Paylo, Grant, and Gudmundsdottir et al., 2011). Also, according to factor loading of items, it could be suggested that item 19 and 20 have not good quality for representing driving anxiety construct.

Our finding about third factor of DBS is consistent with Gray psychophysiological theory of anxiety (1987). According to this theory of anxiety, fight is a possible response toward perceived anxiety. Experiencing high levels of anxiety during driving may lead to externalizing negative feeling by hostility and aggressive reactions like tailgating, honking the horn, insulting, or trying to hit other cars. However this factor only explains a little variance of anxiety driving. It is possible that driver's aggressive behaviors was caused by other factors such as personality traits related to impulsivity, dysfunctional attitudes, or errors which were made during attributing other's drivers behaviors (Nesbit, Conger, 2012).

Results of internal consistency of total scores of DBS and its subscales revealed that they had satisfactory reliability and surely a little error variance. The range of α values of DBS subscales in this study (0.65 to 0.77) was very close to previous studies (Clapp, Baker, Litwack, Sloan, and Beck, 2014).

There were significant relationships between anxiety-based performance deficits and all kinds of errors and traffic rules violations in driving, confirming the convergent validity of DBS. Also, hostility and aggressive behaviors subscale of DBS had direct and convergent relationship with intentional violation subscale of MBDQ and trait anger, but it was not correlated with trait anxiety. These patterns of associations may be a good evidence for convergent and divergent validity of DBS subscales. Furthermore, there were significant association among subscales of DBS and driving errors and violations. It also corroborates convergent validity of DBS.

Another conclusion was drawn with regard to the differential associations between specific aspects of driving with anxiety and driving errors and traffic rules violations. In this regard, drivers who try to use exaggerated safety behaviors do not commit dysfunctional behaviors which lead to road accidents. However, negative effects of anxiety on performance is the main path that could lead to road accidents. Presumably, anxiety occupies information processing systems and by distracting driver's attention from driving and roads conditions endanger people's safety. Anxiety-based performance deficits are

significantly associated with trait anxiety and trait anger. These facts produce another good evidence for convergent validity of DBS.

However in previous studies, anxious driving was delineated as one of the risky driving style characterized by high level of alertness, tension, and inability to apply relaxing skills (Tabuman-ben-Ari, Mikulincer, and Gillath, 2004). Nevertheless, one of the privileges of conceptualizing driving with anxiety in DBS is widening the definition of anxious driving behaviors. Previous studies showed that anxious drivers with higher level of education perceive driving as a threat to life and self-image, whereas anxious drivers with lower level of education perceive driving as a situation that may be important and distressing with regard to social impression (Taubman-Ben-Ari, Yehiel, 2012). So, it is possible to include these motivations as another dimension of driving with anxiety and investigate their relationship with road accidents. Another possible dimension of driving with anxiety construct is social anxiety during driving and cognitive aspects of anxiety like worry and mental preoccupations. These kinds of anxiety might lower performance of drivers and can be considered as an anxiety-based performance deficits.

Any conclusion drawn from this study should consider some of its limitations too. Firstly, majority of participants in this study were university students, so its findings cannot be generalized to other groups of drivers. Secondly, we did not investigate other indexes of reliability such as predictive validity or test-retest reliability. Thirdly, although we ran an exploratory factor analysis on DBS and found a 3-factor solution as predicted, a confirmatory factor analysis is needed to evaluate proposed factor structures of DBS. Finally, participants in this study were not homogenous, some were ordinary drivers and others were taxi drivers.

According to findings of this study, we recommend that intervention programs be designed to target the effects of anxiety on driving behaviors. Based on factor loadings of driving anxiety of DBS, we could conclude that designing skill-based intervention for alleviating anxiety-based performance deficits of anxious drivers have priority over other aspects and manifestations of driving anxiety. Training basic and advanced skills of driving could increase self-efficacy of anxious drivers and decrease their errors and violations that may lead to road accidents. Helping anxious drivers to encounter driving scenarios in simulated or real contexts could decrease exaggerated safety and cautious behaviors. These behaviors are related to avoidance strategy, and by increasing driver's experience, it could be modulated with adaptive safety behaviors. Another treatment target for driving with anxiety is hostility/aggressive behaviors caused by higher levels of anxiety. As these behaviors are associated with intentional violation during driving and trait anger, anger management skills could affect these disruptive behaviors.

By applying DBS to screen drivers' abilities, it is possible to identify hazardous drivers and decrease the rate of road accidents due to anxiety. Another area of DBS application is in the clinical setting. Future studies could investigate the relationship between DBS and other kinds of driving-related fears in individuals with different kinds of anxiety disorders like specific phobia, agoraphobia, or PTSD. We recommend that in future studies psychometric qualities of DBS were evaluated by random sampling and selecting more representative sample of drivers. are discriminating drivers with high and low accident rates.

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