Accident Analysis and Prevention 109 (2017) 78–88

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Full length article

Aggression, emotional self-regulation, attentional bias, and cognitive inhibition predict risky driving behavior

Susan Raouf Hadadi Sani[a], Zahra Tabibi[b,*], Javad Salehi Fadardi[c], Despina Stavrinos[d]

[a] Department of Psychology, Ferdowsi University of Mashhad, Iran
[b] Department of Psychology, Ferdowsi University of Mashhad, Azadi Square, 1518, 9177948991, Mashhad, Iran
[c] Department of Psychology, Ferdowsi University of Mashhad, Iran
[d] Department of Psychology, University of Alabama at Birmingham, 916 19th Street South, 916 Building, Birmingham, AL, 35294 USA

ARTICLE INFO

Keywords:
Anger
Aberrant driving behavior
Emotional stroop task
Risky driving
Inhibition

ABSTRACT

The present study explored whether aggression, emotional regulation, cognitive inhibition, and attentional bias towards emotional stimuli were related to risky driving behavior (driving errors, and driving violations). A total of 117 applicants for taxi driver positions (89% male, *M* age = 36.59 years, *SD* = 9.39, age range 24–62 years) participated in the study. Measures included the Ahwaz Aggression Inventory, the Difficulties in emotion regulation Questionnaire, the emotional Stroop task, the Go/No-go task, and the Driving Behavior Questionnaire. Correlation and regression analyses showed that aggression and emotional regulation predicted risky driving behavior. Difficulties in emotion regulation, the obstinacy and revengeful component of aggression, attentional bias toward emotional stimuli, and cognitive inhibition predicted driving errors. Aggression was the only significant predictive factor for driving violations. In conclusion, aggression and difficulties in regulating emotions may exacerbate risky driving behaviors. Deficits in cognitive inhibition and attentional bias toward negative emotional stimuli can increase driving errors. Predisposition to aggression has strong effect on making one vulnerable to violation of traffic rules and crashes.

1. Introduction

The World Health Organization (2015) reported that motor vehicle crashes (MVCs) were the third leading cause of death in 2012 in Iran. Risky driving behavior is a significant contributor to MVCs (Iversen, 2004; Lawton et al., 1997; Parker et al., 1995). One theoretical framework to study risky driving behavior proposed by Reason et al., (1990) emphasizes two types of risky driving behaviors having two distinctive psychological constructs: errors and violations. Errors refer to the inability to perform a series of designed actions to achieve an optimal outcome. Violations are behaviors performed with the intention of violating traffic regulations. Moreover, research suggested that errors can be split into slips (failure of attention), lapses (failure of memory) and mistakes (failure of intention). Violations can be aggressive containing an interpersonally aggressive component whereas "ordinary" violations are deliberate deviations from safe driving without intention of harm (Lajunen et al., 2004; Özkan et al., 2006). Further studies of risky driving behavior resulted in a more detailed taxonomy of driver errors, which is based on underlying psychological mechanisms including action errors (action execution), cognitive and decision making errors (e.g., perception & attention), observation errors (e.g., memory & recall), information retrieval errors and violations (e.g., planning & intention) (for more details on driver error taxonomy see, Salmon et al., 2010; Stanton and Salmon, 2009). Nevertheless, the distinction between errors and violations of Reason et al. (1990) can be located in "driver error" category of Stanton and Salmon (2009).

A psychological factor particularly relevant to risk taking behavior in driving is feeling of anger and aggression (Deffenbacher et al., 2002; Gonzalez-Iglesias et al., 2012; King and Parker, 2008). Aggression refers to intended action to harm another person, and that the target wills to avoid that. Literature on general aggression has distinguished reactive aggression driven by anger and proactive aggression driven by an ultimate goal other than harm (instrumental) (Berkowitz 1993). However, Anderson and Bushman (2002) stated that the intention of all types of aggression is harming and that such taxonomy is limiting and is not able to consider aggressive acts with multiple motives. Also, in driving situation distinguishing such dichotomy is often not possible due to inability to ascertain the goal and intent of other drivers (King and Parker, 2008). The present study draws upon the general aggression model (GAM), a model of aggression that is equally applicable to both reactive and proactive aggression to examine the relevance of aggression to risky driving (Anderson and Bushman, 2002). The general

* Corresponding author.
E-mail addresses: sraouf022@gmail.com (S.R.H. Sani), tabibi@um.ac.ir, ztabibi@hotmail.com (Z. Tabibi), j.s.fadardi@um.ac.ir (J.S. Fadardi), dstavrin@uab.edu (D. Stavrinos).

http://dx.doi.org/10.1016/j.aap.2017.10.006
Received 27 June 2016; Received in revised form 6 October 2017; Accepted 9 October 2017

aggression model (GAM), provides two points of entry for outcome aggressive behavior. The initial is as either situational (aggressive cues and provocations) or personal factors (e.g., aggressive trait). The second is as an influence on appraisal and decision making, wherein accessibility of hostile concepts in memory and emotions hinders a thoughtful reevaluation of the situation, which may produce an aggressive action (Anderson and Bushman, 2002; Roberton et al., 2012). Roberton et al. (2012) draws upon GAM and explain the impact of maladaptive emotion regulation on aggression. Some research has shown that the cognitive processes of inhibition and emotional self-regulation underlie the experience of the aggression (Anderson and Bushman, 2002; Denson et al., 2012; Pond et al., 2012).

Accepting the concept of aggression within the GAM we tested the following psychological constructs to explain risky driving behavior: Aggression trait, attentional bias, inhibition and emotional self-regulation.

1.1. Personal and situational factors of aggression and risky driving behavior

Previous studies using various methodologies have consistently linked aggressiveness to risky driving behavior (Deffenbacher et al., 2002; Lajunen and Parker, 2001; Mesken et al., 2007; for review, Nesbit et al., 2007). Relying on self-report measures, King and Parker (2008) found that drivers with relatively high levels of trait aggressiveness committed both aggressive and Highway Code violations more likely and that accident-involved drivers were more angry and hostile than accident-free drivers. Studies using a more 'direct' observation of behavior such as simulated driving, replicated earlier subjective/self-report findings. For example, Schwebel et al. (2006) found that anger/hostility predicted risky driving in a computer-simulated, virtual environment, even after accounting for the effects of sex and years licensed. Other researchers have also demonstrated risky driving among anger-prone drivers (Deffenbacher et al., 2003; Garrity and Demick, 2001).

Other lines of research considered state of anger, emphasizing that anger in traffic may be caused by situational factors. Researchers assessed driving behavior of typical (non-anger prone) drivers in anger-provoking driving situations (Mesken et al., 2007; Stephens and Groeger, 2011). Results showed that anger-provoking situations are often influenced by recent driving constraints such as road construction (Mesken et al., 2007; Stephens and Groeger, 2011). Mesken et al. (2007) recorded driving speed and emotional state of drivers while they were actually driving, showing that even low levels of anger may impact driving behavior such as an increased speed.

The interrelationship between personal and situational factors in traffic situations have also been widely examined (Roidl et al., 2014; Stephens and Groeger, 2009; Stephens et al., 2012). Anger provocation in a sample of non-anger prone individuals lead to an increased tendency to underestimate the potential traffic hazards in a simulated driving task. In low anger-provoking situations, drivers higher in trait anger reported more anger and frustration and drove at higher speeds (Stephens and Groeger, 2009). High trait anger drivers show higher state anger, more aggression, and more risky behavior than low trait anger drivers (Deffenbacher et al., 2003; Roidl et al., 2014). Despite this finding, Stephens and Groeger (2009) found that in their sample those drivers displaying average aggression levels demonstrated no relationship between anger predispositions and general driving behaviors.

1.2. Inhibition, aggression, and risky driving behavior

Inhibition, the ability to prevent a strong, prepotent response, is an essential prerequisite for a variety of cognitive functions. Impaired inhibition might be a source of impulsivity, attention deficits, aggression, poor self-regulation and decision making (Aron, 2007; Denson et al., 2012; DeWall et al., 2011). Impulsivity refers to a general tendency towards quick, unthoughtful actions without a consideration of the consequences of these actions (Moeller et al., 2001). Also, some driving parameters may negatively be affected by impaired inhibition (e.g., Cheng et al., 2012; Constantinou et al., 2011; Dahlen et al., 2005; Galovski and Blanchard, 2004; O'Brien and Gormley, 2013; Poó and Ledesma, 2012; Rizzo et al., 2003; Thompson et al., 2007; Wickens et al., 2008). For example, compared to young drivers with no offenses, those with offenses showed poorer inhibitory control as measured by the Go/No-go task (O'Brien and Gormley, 2013). In Iran, a study showed that individuals with poor inhibitory control made more errors and violations in driving, and may experience a higher number of motor vehicle crashes (Tabibi et al., 2015).

1.3. Selective attention and risky driving behavior

Driving performance may be impaired if drivers are not paying adequate attention to driving tasks in critical moments (Zhang et al., 2014; Wickens et al., 2008). Driver distraction is estimated to be one of the leading causes of MVCs (National Highway Traffic Safety Administration, 2010).

Some studies have examined driver distraction resulting from performing secondary tasks while driving, such as cell phone conversations, eating, and adjusting in-vehicle controls (e.g., Stavrinos et al., 2015; Strayer and Johnston, 2001; Stutts et al., 2005). Recent studies have pointed to the impact of emotions on distractions (Pêcher et al., 2009). Research shows that attention can be biased, or shifted, toward emotional, task-irrelevant stimuli while performing a cognitive task. Such effect is called attentional bias.

1.3.1. Attentional biases

One cognitive deficiency induced by anger is attentional bias (Eckhardt and Cohen, 1997). Attentional bias is a phenomenon in which despite efforts to ignore irrelevant stimuli, attention is directed toward it (Fadardi and Ziaee, 2010; Williams et al., 1996). Williams et al. (1996) noted that increasing emotional valence, the extent to which an individual is attracted or repelled by an object, event or person is accompanied by processing bias of that stimuli coding. Considerable evidence suggests that emotional stimuli compete with other stimuli for attentional resources (Fadardi and Cox, 2005; Fadardi and Ziaee, 2010; Williams et al., 1996). Some studies have measured attentional bias in different groups of participants with the expectation that one group of participants displays greater bias than another group due to differing personality traits. For example, aggressive participants showed attentional bias in emotional Stroop tests and Go/No-go tasks. Such attentional bias is observed toward face stimuli and aggressive terms (Bertsch et al., 2009; Smith and Waterman, 2003, 2005; Williams et al., 1996). Also, people experiencing anxiety or depression display a higher level attentional bias (Eckhardt and Cohen, 1997). Fadardi and Cox (2005) demonstrated that beyond the impact of cognitive performance and general inhibition of ability, stimuli related to one's preoccupations are more likely to be influenced by selective attention.

Whether individual differences in attentional bias in emotional situations alters driving behavior is not fully understood. In the context of driving, there are studies proposing that emotional states, such as anger, sad or happy may misdirect attention and lead to driver distraction (Chan and Singhal, 2013; Neale et al., 2005; Pêcher et al., 2009). The results are however, equivocal. For example, in a driving situation, it is found that sad music led to risk-free driving whereas happy music was associated with more dangerous driving such as higher driving speed, and higher frequency of traffic violations, including disregarding red traffic-lights, lane crossings, and collisions in a simulated driving task (Brodsky, 2002; Pêcher et al., 2009).

1.4. Emotional self-regulation, aggression and risky driving behavior

Emotional self-regulation involves strategies to manage current

emotions, their expression, and their experience in a manner that is socially tolerable and sufficiently flexible (Gratz and Roemer, 2004). Skills thought to underlie emotional self- regulation include emotional awareness, emotional acceptance, ability to control impulsive behavior, modulating emotion to guide behavior and proficiency in a variety of emotion regulation strategies (Gratz and Roemer, 2004; Roberton et al., 2012). Individuals with difficulty in regulating emotional states are more likely to behave aggressively, show impulsivity, and have a tendency toward risky behavior (Denson et al., 2012; Magar et al., 2008; Pond et al., 2012; Rivers et al., 2013; Roberton et al., 2012; Schreiber et al., 2012).

Pond et al. (2012) studied one aspect of emotion regulation by having participants differentiate their emotions into discrete categories utilizing diary studies. They showed that people who reported feeling more intense anger and those who were better at differentiating among their negative emotions were less susceptible to aggression. With regard to risky behavior, Rivers et al. (2013) found college students' tendency toward risky behavior was related to emotional intelligence. In fact, the study demonstrated that two components of emotional intelligence, perceiving emotions and managing emotions, had unique relations to risky behavior. Few studies have considered the role of emotional self-regulation in driving behavior. Hancock et al. (2012) found that utilization of emotional self-regulation strategies, task-focused or emotion-focused, related to safe driving. Task-focused females and emotion-focused males drove more closely to the speed limit than their non-focused peers in a driving simulator task.

1.5. The present study

Various studies have demonstrated a link between high trait aggression and poor driving outcomes. Also, there are studies indicating that inhibition and emotional self-regulation play a significant role in modulating the experience of aggression. Moreover, studies indicate that aggression might be provoked by conflicting situations, and that the rise of emotional level may lead to attentional bias. We were interested in determining whether aggressive trait, inhibition, emotional self-regulation and attentional bias affect risky driving behavior. We were interested in using the emotional Stroop methodology, a modified version of classical Stroop, to examine the effect of emotions on distracting attention. In particular, we wanted to see whether the presence of aggressive emotional stimuli will lead to attentional bias; and that the tendency toward attentional bias in the presence of aggressive emotional stimuli will be related to risky driving behavior.

We examined the effects separately for driving errors, driving violations and total risky driving behavior as assessed by the Driving Behavior Questionnaire. DBQ proposes four types of risky driving behavior, errors, lapses, ordinary violation and aggressive violation (Reason et al., 1990). However, Lajunen et al. (2004) found two second-order factors deliberate violations included "ordinary" violation and aggressive and unintentional errors included errors and lapses from the four first-order factors. Also, cross cultural comparisons as well as studies in various countries have consistently demonstrated the distinction between errors and violations (Lajunen et al., 2004; Özkan et al., 2006).

If attention is biased because of emotional stimuli then we hypothesized 1) higher scores in attentional bias would be related to higher risky driving behavior, and that the correlation would be higher for driving errors than driving violations; 2) higher reports of aggression would be related to more risky driving behavior, and that aggression would be more strongly correlated to driving violations than driving errors; 3) higher difficulty in emotional regulation would be related to more risky driving behavior, and that difficulties in emotion regulation would be more strongly correlated to driving violations than driving errors; and 4) higher inhibition would be related to lower risky driving behavior, and that inhibition would be more strongly correlated to driving errors than driving violations.

2. Method

2.1. Participants

A total of 117 available drivers (89% male) who were applicants for taxi driver positions and attending a course in Mashhad Traffic Cultural Center participated in this study. The mean age of participants was 36.59 years (SD = 9.39 years; range 24–62 years). All participants had a full driver's license and had been driving for at least a year. Years of driving experience were between 1 and 40 years (M = 12.45, SD = 8.97). Average hours of driving per day ranged from 1 to 12 h (M = 6.30, SD = 2.93). The majority (61.1%) of participants reported no MVCs over the last year; 27.4% experienced one crash; and the remaining participants reported 2 or more crashes over the last year. Approximately half (47.2%) of the participants reported not having been fined by police officer over the last year, 30.2% reported one fine, and the remaining participants reported 2 or more fines issued by police officers over during the last year.

2.2. Instruments

We administered three questionnaires and two computerized tests as follows:

The **Ahwaz Aggression Inventory** was used to measure aggression (Zahedifar et al., 2000). This is a culturally adapted questionnaire. Although feelings of aggression might be somewhat culture-free, there are important aspects of aggressive behaviors which are culture-dependent (Bond, 2004). For example, it is almost normal to interrupt two persons conversation for greeting or asking them questions, whereas in some Western cultures this might irritate people. Another example is driving behavior. Iranian drivers do not find it truly bizarre to cut another driver and steal his/her right of way, but they can feel really frustrated if a driver stops for pedestrians even if they are crossing inside of a marked crosswalk. Therefore, standard questionnaires based on the Western culture cannot be valid and reliable enough to measure aggressiveness in an Eastern culture. To compensate for the shortcoming, Zahedifar et al. (2000) used culture-free items from inventories such as Buss and Durkee (1957) and Cattell et al. (1970) and added items that are more pertinent to Iranian culture and developed Ahwaz Aggression Questionnaire (AAQ). It includes 30 items using a 4-point Likert scale (0 = never to 3 = always). The authors have reported good validity and reliability for the questionnaire. The test-retest method resulted in a correlation coefficient of .70 (Zahedifar et al., 2000). Higher scores indicated higher predisposition to aggression. Table 1 presents the results of Principal Component Analysis (PCA) with Varimax rotation for Ahwaz Aggression Inventory – Persian (Zahedifar et al., 2000).

The **Difficulties in Emotion Regulation Questionnaire – Persian Version.** (Gratz and Roemer, 2004) consists of 36 items and measures 6 difficulties in emotion regulation including Nonacceptance of Emotional Responses (NONACCEPTANCE), Difficulties Engaging in Goal-Directed Behavior (GOALS), Impulse Control Difficulties (IMPULSE), Limited Access to Emotion Regulation Strategies (STRATEGIES), Lack of Emotional Clarity (CLARITY), and Lack of Emotional Awareness (AWARENESS), using a 5-point Likert scale (1 = almost never, 5 = almost always). The scale has high internal consistency (.93) and all six subscales have Cronbach's alpha of over .80 (Gratz and Roemer, 2004). In Iran, exploratory factor analyses of the Persian version, represented 6 factors and resulted in removal of 3 items (i.e., When I'm upset, I take time to figure out what I'm really feeling; When I'm upset, I believe that my feelings are valid and important; When I'm upset, I know that I can find a way to eventually feel better). The reliability of the subscales for the Persian version was between .66 and .88 using Cronbach's alpha. A test-retest analysis showed correlation coefficients between .79 to .91 indicating an acceptable reliability (Khanzadeh et al., 2012). For the current study Cronbach's alpha was

Table 1
PCA with Varimax rotation for Ahwaz Aggression Inventory – Persian.

Items	Factor 1	Factor 2	Factor 3
Certain minor issues make me nervous.	.59		
When I think about past events, I feel dismayed.	.58		
I do lots of things that make me regret.	.57		
When something gets in my way to do my plan, I feel angry.	.57		
Unfairness make me angry.	.56		
I can't tolerate failure.	.55		
Even when I hide my anger from others, I think about it for a long time.	.54		
Some of my friends have certain habits that make me nervous.	.53		
I blame myself.	.49		
Others' foolish acts make me angry.	.49		
I feel a heavy burden on my shoulders.	.48		
I get angry when others criticize me.	.48		
When people delay, I get angery.	.47		
When I couldn't get my way, I feel upset	.46		
When I get angry I couldn't control my words		.63	
When I get angry, I insult others		.57	
When I get angry I display irrational behavior		.51	
I am persistent in my views.		−.51	
When I get angry I hit others		.50	
When I get angry I threw things.		.49	
Bad thought in my head makes me embarrassed.		.48	
Others consider me as a violent person.		.45	
If a salesperson mistreats me, I yell at him/her.			.57
If someone says something stupid to me, they get what they deserve.			.56
When a car passes carelessly, I shout at the driver.			.55
I fight with anyone who insults me or my family.			.53
If someone hurts me, I will hurt him/her.			.53
I am interested in rough sports.			.49
People, who hurt me, look for trouble.			.46
When others disagree with me, I argue with them.			.46
Eigenvalue	14.9	4.13	3.57
Explained variance	15.9	4.4	3.8
Cronbach's alpha	.87	.85	.76
Cronbach's alpha (Current study sample)	88	.67	.82

Factor 1: anger and nervousness; Factor 2: aggressive and insulting; Factor 3: obstinacy and revengeful; KMO = .85, $p < 0.001$; Bartlet's $\chi^2 = 1255$, $p < .001$; Total explained variance = 24.1.

Table 2
PCA with Varimax rotation for Difficulties in Emotion Regulation Questionnaire – Persian Version.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Eigenvalue	73.9	3.91	3.79	52.4	2.38	1.99
Explained variance	11.02	10.86	10.53	8.06	6.16	5.55
Loaded variables	7	5	6	3	6	6
Mean	24.72	34.14	20.70	10.96	20.60	21.20
SD	6.52	4.46	5.16	2.66	4.46	5.56

Factor 1 = NONACCEPTANCE, Factor 2 = GOALS, Factor 3 = IMPULSE, Factor 4 = CLARITY, Factor 5 = AWARENESS, Factor 6 = STRATEGIES; KMO = .91, $p < 0.001$; Bartlet's $\chi^2 = 5.60$, $p < .001$; Total explained variance = 51.36; minimum factor loading = .30.

.87. Higher scores indicated greater difficulties with emotional self-regulation. Table 2 presents the results of PCA with Varimax rotation for Difficulties in Emotion Regulation Questionnaire – Persian Version (Khanzadeh et al., 2012).

The Persian version of the **Driver Behavior Questionnaire (DBQ)** (Lajunen et al., 2004) that assesses different types of risky driving behavior, including violations and errors, was administered. The questionnaire had 27 items and participants indicated how often they behaved in the way described by each item, using a 6-point scale (0 = never to 5 = almost always), with higher scores indicating more risky driving behavior. In the current study, the DBQ total score, and the scores for the subscales, namely, Errors and Violations were analyzed. The DBQ has been previously administered in Iran and have resulted in high internal consistency and good test-retest reliability (Özkan et al., 2006; Tabibi et al., 2015). The distinction between errors and violations in DBQ has consistently been found across cultures (Lajunen et al., 2004; Özkan et al., 2006). For the current study Cronbach's alpha was .89 for total score and .80 and .85 for Violations and Errors, respectively.

Also, for the current study, to confirm the two factors Errors and Violations a Confirmatory factor analysis using Amos was computed. The results are reported in Table 3.

A computerized version of the **Emotional Stroop task,** a laboratory developed measure based off previous similar tasks (Fadardi and Ziaee, 2010) was provided to measure attentional bias. The task was run using Superlab software (Cedrus-Corporation, 1999). Generally, the emotional Stroop task presents a variety of words, including emotional words (e.g., threatening) and neutral words, in different colors. Participants are requested to say the color of the word as quickly and accurately as possible, while ignoring its semantic content. The high response time in saying the color of the emotional words compared to neutral words implies attentional bias and is called the emotional interference score.

For the current study, the emotional Stroop Test's procedure was extended to include emotionally provoked scenarios. We used emotional words related to aggressive driving behaviors as well as words related to non-driving negative emotions. The word stimuli were written in different colors (red, yellow, green and blue). Based on Hu et al. (2013), we also showed clips presenting a potential anger-provoking event in order to elicit a negative emotional state. The participant's task was to watch the clip after which they were required to identify the color of the word stimuli. Interference or attentional bias was calculated by subtracting the average response time to neutral words from the average response time to emotional words. In addition, we administered the classic Stroop task, to account for the variance of its interference score in later statistical analyses.

A variety of clips presenting both emotional traffic situations and non-traffic events were shown to a number of drivers and non-drivers to determine whether the clips elicited the negative emotion of anger. The six clips (three traffic related, three non-traffic related) with highest rating in terms of anger emotions were selected. The three clips of emotional traffic situation were running red lights at elevated speeds, road rage driving, and tailgating. The three clips of emotional non-traffic events were clashes, skirmishes, and fights in football and a boxing match. Additionally, three neutral clips of a driving situation (without any violations) were selected. The duration of each clip was 30 s and the interval between the presentation of clips and words was 5000 milliseconds.

Following the presentation of the clips, participants selected traffic related negative emotional words, non-traffic related negative emotional words, and neutral words. The following procedure for selecting emotional and neutral words was taken. First, based on the literature, a check-list of aggressive driving behaviors was presented to a number of individuals. These individuals indicated what emotional state(s) the behaviors elicited and rated the strength of that emotional state on a scale from zero to ten. Words that were frequently identified with high negative emotional levels were selected. Non-traffic negative emotional words and neutral words (with zero emotional level) were similarly selected. The negative emotional and neutral words were homogenized with regard to the mean number of letters (average 5 letters), mean number of syllables (average 2), and semantic relationship. At the end, seven words were chosen for the high negative emotion, non-traffic, and neutral categories. The negative emotion words related to aggressive driving behavior were identified as tailgating, weaving in and

Table 3
Goodness-of-Fit Indicators of two-factor solution for DBQ: item loadings, fit indexes, chi-square, and degree of freedom values.

Item number, factor & the item	
Q4 ⟵ Errors Queuing to turn left onto a main road, you pay such close attention to the main stream of traffic that you nearly hit the car in front.	.58
Q5 ⟵ Errors Fail to notice that pedestrians are crossing when turning into a side street from a main road.	.47
Q7 ⟵ Errors Fail to your rear-view mirror before pulling out, changing lanes etc.	.59
Q8 ⟵ Errors Brake too quickly on a slippery road, or steer the wrong way in a skid.	.35
Q12 ⟵ Errors On turning right, nearly hit a cyclist who has come up on your inside.	.48
Q13 ⟵ Errors Miss "Give Way" signs, and narrowly avoid colliding with traffic having right of way.	.50
Q15 ⟵ Errors Attempt to overtake someone that you hadn't noticed to be signalling a left turn.	.63
Q26 ⟵ Errors Underestimate the speed on an oncoming vehicle when overtaking.	.61
Q1 ⟵ Errors Hit something when reversing that you had not previously seen	.39
Q2 ⟵ Errors Intending to drive to destination A, you "wake up" to find yourself on the road to destination B, perhaps because the latter is your more usual destination.	.54
Q3 ⟵ Errors	.54
Q11 ⟵ Errors Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers.	.41
Q14 ⟵ Errors Attempt to drive away from the traffic lights in third gear.	.57
Q18 ⟵ Errors Forget where you left your car in a car park.	.50
Q21 ⟵ Errors Misread the signs and exit from a roundabout on the wrong road.	.60
Q25 ⟵ Errors Realise that you have no clear recollection of the road along which you have just been travelling.	.46
Q9 ⟵ Violations Pull out of a junction so far that the driver with right of way has to stop and let you out.	.54
Q10 ⟵ Violations Disregard the speed limit on a residential road.	.79
Q17 ⟵ Violations Stay in a motorway lane that you know will be closed ahead until the last minute before forcing your way into the other lane.	.43
Q19 ⟵ Violations Overtake a slow driver on the inside.	.63
Q20 ⟵ Violations Race away from traffic lights with the intention of beating the driver next to you.	.26
Q22 ⟵ Violations Drive so close to the car in front that it would be difficult to stop in an emergency.	.66
Q23 ⟵ Violations Cross a junction knowing that the traffic lights have already turned against you.	.55
Q27 ⟵ Violations Disregard the speed limit on a motorway.	.78
Q6 ⟵ Violations Sound your horn to indicate your annoyance to another road user.	.38
Q16 ⟵ Violations Become angered by another driver and give chase with the intention of giving him/her a piece of your mind.	.40
Q24 ⟵ Violations Become angered by a certain type of driver and indicate your hostility by whatever means you can.	.36
$\chi 2$ (df = 323) = 535.56 RMSEA = 0.07 CFI = 0.75* $\chi 2$/df = 1.66	

Note: A good fit of model should, in general, have 2:1 or 5:1 $\chi 2$/df, CFI > 0.90, and RMSEA < 0.10 (preferably < 0.05) indexes. *The CFI on this is not great. It is likely to do with the small sample size (Marsh et al., 1988).

out, fish tailing, accident, crash, deviation, and danger. The non-traffic negative emotional words were anger, conflict, humiliation, intimidation, beatings, insults, and hatred. The neutral words were zebra crossing, gear, clutch, pedals, parking, and tunnel. The font size of words was 150 and each word was displayed on the screen for 2000 milliseconds and with the interval of 500 milliseconds. In whole, there were 284 trials, including 32 trails for classic Stroop task. The 252 trials in emotional Stroop task were presented in 9 blocks of 28 trials. Fig. 1 presents a visual model of the task.

The combination of emotional clips with words was counterbalanced. Each category of clips was presented with three categories of words: clips of emotional traffic situation were presented once with words consistent with their emotions, once with non-driving negative emotion words, and once with neutral words. The same procedure was used for the clips of emotional non-traffic events. To eliminate the effects of practice, the order in which the clips and words were presented was counterbalanced creating 6 different versions of the task. In order to prevent a biased Stroop effect, all participants conducted the classic Stroop task first.

Fadardi and Ziaee (2010) conducted a test-retest reliability and factor analysis with the emotional and classical Stroop tests, finding an internal consistency of the interference of emotional words as .80. For the current study Cronbach's alpha was .73.

No responses and wrong responses (i.e., naming the color of the words incorrectly) were excluded from data. Only the response time of correct responses was taken into account. In addition, unrealistic responses, very fast responses (e.g. > 300 ms) or very slow responses (e.g. < 1200) were excluded. To calculate the interference score, the average response time to an easy class (neutral words) was deducted from the average time to respond to difficult class (Fadardi and Ziaee, 2010)., therefore:

- The score for negative emotional interference = *the average response time to neutral clips with neutral words–the average response time to negative emotional clip with negative emotional words.*
- The score for classic Stroop interference = *the average response time to the congruent words–average response time to incongruent words.*

The results obtained from classic Stroop interference scores were used as an indicator of the inhibition processes and cognitive flexibility. Lower scores indicated higher interference scores. The scores of negative emotional interference were considered an indicator of attentional bias to negative emotional stimuli. Lower scores indicated higher interference scores.

The **Go/No-Go Task** was used to measure cognitive inhibition. An fMRI study (Morooka et al., 2012), investigating the neural reactivity of the brain during completing both Stroop and Go/No-go tasks revealed that the tasks tap different aspects of selective attention and response inhibition. Consequently, the authors suggested that a combination of the two tasks will be useful in the multifaceted assessment of selective attention and response inhibition; the two cognitive processes are considered important in driving behavior. Therefore, to reduce the number of tests administered and to cover both processes in a single administration, a novel Go/No-go task using the classic Stroop color word stimuli was developed. Participants were presented with blocks of color words (blue, green, yellow, and red) and asked to press Space key to the word congruent with its color ink and not press any key to the word incongruent with its color ink. A total of 100 trials with 70% Go stimuli (congruent color-words) were presented. Stimuli were presented for 3000 milliseconds and the interval between the presentation of stimuli 500 milliseconds. Two scores were obtained: (1) response time to Go stimuli, (2) and number of errors (including both errors of commission and omission). Fig. 2 provides a visual presentation of the

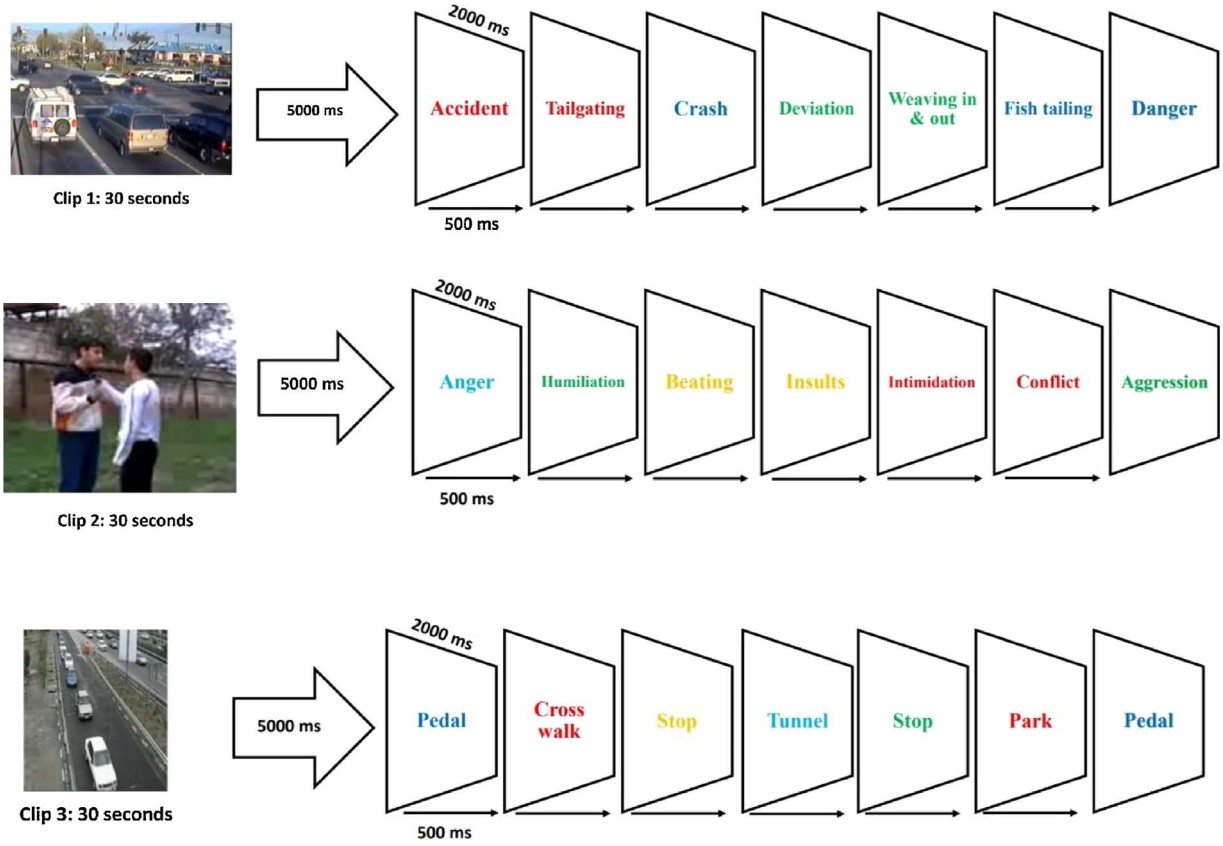

Fig. 1. Visual presentation of Emotional Stroop task. Clip 1 presents a traffic-related emotional situation. Clip 2 presents non-traffic related emotional situation. Clip 3 presents emotionally neutral situation. Participants are required to press the following keys for colors of each word: red color = "?" key; yellow color = "m" key; green color = "c" key; blue color = "z" key. The color of each key was identified with corresponding color sticks. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

task.

2.3. Procedure

Participants were recruited through volunteering when attending a course in Mashhad Traffic Cultural Center. All participants provided signed informed consent. The computerized tasks were administrated using a DELL 16 inch laptop in a private area within a well-lit room. All participants provided demographic information such as age, gender, number of hours of driving per day, number of years of driving, years of driving license, the number of motor vehicle crashes, and the number of fines in the prior 12 months. A crash was defined as any kind of collision, with results ranging from a minor damage to the car to the death of a person, whether culpable or not. The administration order of the remaining tasks were as follows: emotional Stroop task, Go/No Go Task, DBQ, Ahwaz aggression inventory (AAI), and Difficulties in Emotion Regulation Questionnaire. The procedure took approximately 1 h.

3. Results

Outlier detection indicated that one participant's score from the emotional Stroop scores and one from errors of the Go/No-go task were over 3 SD and were removed. Pearson correlation coefficients, a parametric statistic, were computed among scores on the DBQ (total, driving errors & driving violations), the AAI, Difficulties in emotion regulation, the Stroop, and the Go/No-go tasks. All three DBQ scores correlated significantly with interference score (RT) of the classic Stroop task. Those with higher scores on total DBQ and its subscales had higher scores of interference in classic Stroop task. Only scores of driving error were positively correlated to response time of the Go/No-go task.

These results are presented in Table 4.

A partial correlation coefficient was computed between scores on the emotional Stroop task (Mean = −140.14, *SD* = 483.07) and DBQ scores with the interference score of classic Stroop task as covariate. This correlation was calculated to remove the shared variance of the classic Stroop scores with that of the emotional Stroop task. Results are presented in Table 5.

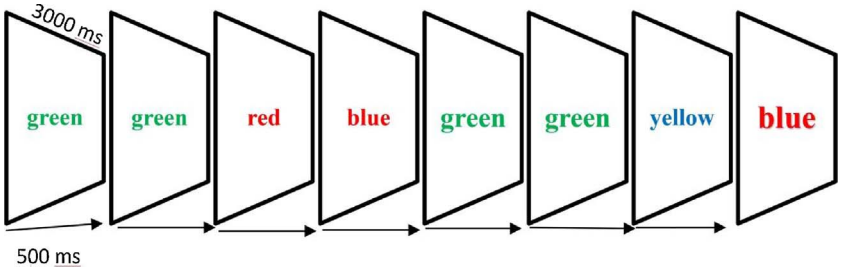

Fig. 2. visual presentation of the Go/No go stimuli. Congruent color-words should be responded by pressing space bar (go stimulus). Incongruent color-words requires no response (no go stimulus).

Accident Analysis and Prevention 109 (2017) 78–88

Table 4
Pearson correlation coefficients between DBQ (driving errors & driving violations), Ahwaz aggression scale, Classic Stroop and Go/No-go tasks.

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.DBQ (total score)	.59	.45	1															
2.Driving errors	.60	.48	.92***	1														
3.Driving violations	.62	.52	.83***	.59***	1													
4.AAI (total)	.74	.41	.67***	.56***	.68***	1												
5.Anger & nervousness	1.01	.55	.59***	.52***	.57***	.90***	1											
6.Aggressive & insulting	.56	.38	.53***	.43***	.57***	.78***	.54***	1										
7.Obstinacy & revengeful	.47	.48	.54**	.46***	.55***	.77***	.49***	.61***	1									
8.NONACCEPTANCE	2.66	.88	.31	.32***	.23*	.36***	.46***	.17	.15	1								
9.GOALS	2.60	.91	.40***	.37***	.32***	.48***	.53***	.30**	.25**	.36***	1							
10.IMPULSE	2.06	.80	.51***	.50***	.40***	.57***	.52***	.47***	.42***	.44***	.63***	1						
11.STRATEGIES	2.08	.80	.44***	.45***	.30*	.42***	.46***	.27**	.26**	.53***	.51***	.68***	1					
12.CLARITY	2.37	.99	.32	.30**	.28**	.37***	.39***	.24**	.17	.24**	.48***	.42***	.38***	1				
13.AWARENESS	2.06	.67	.08	.12	.04	.12	.09	.09	.11	.019	.00	.11	.11	.02	1			
14.Difficulties in Emotion regulation (total score)	2.30	.55	.52***	.52***	.39***	.57***	.62***	.37***	.33**	.73***	.71***	.81***	.83***	.58***	.28**	1		
15.Classic Stroop (interference RT)	−112.64	142.54	−.22*	−.18*	−.20*	−.17	−.15	−.12	−.15	−.19*	−.15	−.16	−.24**	−.09	−.15	−.24**	1	
16.Go/No-go (RT)	546.01	92.89	.17	.21*	.08	.02	.06	.01	.04	.17*	.06	.00	.09	.01	−.16	.05	−.21*	1
14.Go/No-go (error)	2.73	2.59	.15	.18	.05	.07	.12	.04	.01	.25**	.09	.11	.11	.08	−.04	.16	−.16	.32***

NONACCEPTANCE = Nonacceptance of Emotional Responses; GOALS = Difficulties Engaging in Goal-Directed Behavior; IMPULSE = Impulse Control Difficulties; STRATEGIES = Limited Access to Emotion Regulation Strategies; CLARITY = Lack of Emotional Clarity; AWARENESS = Lack of emotional awarenes.

* $p < .05$.

** $p < .01$ level.

*** $p < .001$.

Table 5
Partial correlation coefficient scores in emotional Stroop task and DBQ scores with interference score of Stroop task as covariate.

	DBQ	Driving errors	Driving violations
Attentional bias			
Emotional Stoop	−.19*	−.22*	−.13

$p < .05$.

Table 6
Regressing total score of DBQ, driving errors and driving violations on scores of Ahwaz aggression scale, emotional regulation, Go/No-go, classic Stroop and emotional Stroop tasks.

Predictors of driving violations	B	SE	β	t
Aggression				
Anger and Nervousness	.271	.100	.278	2.708**
Aggressive and Insulting	.276	.136	.208	2.038*
Obstinacy and Revengeful	.301	.111	.262	2.716**
Difficulties in emotion regulation (total score)	.039	.090	.041	.439
Cognitive inhibition Go/No-go task				
RT	.001	.001	.064	.799
Error	−.003	.016	−.016	−.207
Cognitive inhibition Classic Stroop task				
Interference score (RT)	−.003	.001	−.086	−1.082
Attentional biased Emotional Stroop task				
Emotional Interference score (RT)	.000	.000	−.065	−.842
Predictors of driving errors				
Aggression				
Anger and Nervousness	.077	.086	.091	.894
Aggressive and Insulting	.061	.117	.053	.526
Obstinacy and Revengeful	.233	.095	.234	2.447*
Difficulties in emotion regulation (total score)	.283	.077	.337	3.671***
Cognitive inhibition Go/No-go task				
RT	.001	.000	.197	2.476*
Error	.010	.014	.054	.699
Cognitive inhibition Classic Stroop task				
Interference score (RT)	.000	.001	−.059	−.756
Attentional biased Emotional Stroop task				
Emotional Interference score (RT)	.000	.000	−.214	−2.797**
Predictors of DBQ (total score)				
Aggression				
Anger and Nervousness	.16	.08	.200	2.03*
Aggressive and Insulting	.151	.108	.13	1.399
Obstinacy and Revengeful	.238	.088	.250	2.710**
Difficulties in emotion regulation (total score)	.185	.071	.23	2.599*
Cognitive inhibition Go/No-go task				
RT	.001	.000	.14	1.856
Error	.007	.012	.04	.545
Cognitive inhibition Classic Stroop task				
Interference score (RT)	.000	.000	−.07	−1.028
Attentional biased Emotional Stroop task				
Emotional Interference score (RT)	.000	.000	−.144	−1.952

* $p \leq 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Table 5 shows that after accounting for the variance of the classic Stroop interference score, the emotional Stroop interference score still remained significantly correlated with the DBQ and with driving error.

Table 6 shows the results of three separate hierarchical regressions with the DBQ, driving errors and driving violations as criterion variables, and scores on the AAI subscales, the Go/No-go task, the classic Stroop task, the emotional Stroop task, and Difficulties in emotion regulation as predictor variables. Because five of the six subscales of

Difficulties in emotion regulation were significantly related to all variables of the DBQ, total score for Difficulties in emotion regulation was entered (see Table 4).

With regard to the driving violations score of the DBQ, the model was significant (R2 = .46, ΔR2 = .42, F(8101) = 10.67, $p < .001$). Table 6 shows that all three subscales of AAI that is anger and nervousness (.28), obstinacy and revengeful (.26) and aggression and insults (.21) were significant, accounting for 46% of variance. The remaining cognitive variables were non-significant.

With regard to the driving errors score of the DBQ, the model was significant (R2 = .47, ΔR2 = .42, F(8101) = 11.8, p < .001). Table 6 shows that obstinacy and revengeful subscale of AAI (23%), emotional regulation (34%), emotional Stroop (21%) and Go/No go response time (20%) were significant variables. The remaining cognitive variables were non-significant.

With regard to the DBQ total score, the model was significant (R2 = .51, ΔR2 = .47, F(8101) = 12.9, $p < .001$). Table 6 shows that two subscales of AAI, anger and nervousness (20%) and obstinacy and revengeful (25%), and emotional regulation (23%) were significant, accounting for 51% of variance. The remaining cognitive variables were non-significant.

At the end, since, 39% of the sample reported having at least one crash in the previous year, we took this opportunity to look at differences between the sub-sample of crash involved drivers (n = 44) with the crash free sub-sample (n = 67) in terms of all study variables. We computed *t*-test to examine the differences. Results indicated that crash-involved drivers scored significantly higher in driving errors (t109 = 1.99, p = .048); angry and nervousness of AAI (t108 = 2.52, p = .013); obstinacy and revengeful of AAI (t109 = 2.50, p = .014); AAI total score (t109 = 2.83, p = .005); GOALS (t109 = 2.12, p = .035) and CLARITY (t109 = 2.19, p = .03) of Difficulties in emotion regulation.

4. Discussion

The current study sought to determine whether risky driving behaviors, including driving errors and driving violations, were related to aggression, inhibition, difficulties in emotion regulation and attentional bias.

In the correlational analyses, results indicated that aggression, emotional self-regulation, and cognitive inhibition assessed by the classic Stroop task related significantly to driving violations. Individuals with a higher tendency to aggression, more difficulty in regulating emotions, and poorer inhibitory control were those reporting higher numbers of driving violations. Considering driving errors of DBQ, all components of aggression as well as emotional self-regulation, except lack of emotional awareness, were significantly associated with higher reports of driving errors in DBQ. People who showed a diminished capacity for regulating their emotional state were more likely to make errors in driving. Reaction time of the Go/No-go task was related to driving errors. Drivers with poor cognitive inhibitory ability reported higher rate of driving errors. This correlation is further supported by the significance of the classic Stroop interference score for driving errors. Also, the interference score of the emotional Stroop task related to driving errors. Those with a higher tendency to attentional bias reported a higher rate of driving errors. Considering total score of DBQ, all components of aggression as well as that of difficulties in emotion regulation, except lack of emotional awareness, significantly related to risky driving behavior as measured by the DBQ total score. Those having higher scores in aggression trait were more likely to report risky driving behavior than those with lower scores in aggression trait. Also, those having more difficulties with emotional self-regulation were more likely to show risky driving behavior. The interference score of the emotional Stroop task related to risky driving behavior with those drivers displaying a higher tendency to attentional biases when encountering emotional stimuli, and being more likely to report committing risky driving behavior than those without such a high tendency.

In the regression analyses, the results indicate that all three components of aggression that are anger and nervousness, obstinacy and revengeful and aggression and insults could predict driving violations as much as 46%. Those with a higher predisposition to feel angry, frustrated, provoked, and revengeful are more likely to commit driving violations. The remaining variables, including cognitive inhibition assessed by the Go/No-go and the Stroop tasks, and attentional bias assessed by the emotional Stroop task, were not significant suggesting that aggression trait is important psychological factor in driving violations. This is consistent with studies indicating that drivers scoring high on trait aggression tend to experience more emotions in specific traffic situations (e.g., traffic jam, slow traffic, slow car or encountering inappropriate behavior by other drivers) than others, and, as a result, drive faster and generate more traffic violations (Deffenbacher et al., 2003; Mesken et al., 2007; Roidl et al., 2014).

Furthermore, regression analysis indicated that difficulties in emotion regulation (34%), obstinacy and revengeful component of aggression (23%), emotional Stroop (21%) and Go/No-go response time (20%) influenced driving errors. Difficulty regulating emotions was predictive of driving errors, even after adjusting for the other variables in the model. This result is in line with studies indicating that poor strategies for regulating emotional states and the inability to self-calm may lead one to behave aggressively, show impulsivity and have a tendency toward risky behavior (Magar et al., 2008; Rivers et al., 2013; Roberton et al., 2012; Schreiber et al., 2012). Difficulties with emotional regulation, the inability to stay calm and focused while driving, may result in unsafe driving behaviors. Drivers who are better at adapting strategies to regulate their emotions may experience less distress over the intense emotions experienced in traffic situations. These people may have the ability to engage in desired behaviors when experiencing negative emotions, to maintain calmness in situations where others would feel overwhelmed or out of control, as well as to concentrate and focus on the task of driving in a stressful traffic situation.

Also, drivers who scored higher on the obstinacy and revengeful component of aggression were more likely to report higher driving errors on the DBQ. Those who think of revenge easily when insulted or frustrated are more likely to make errors while driving. It seems that tendency to revenge and stubbornness leads one to errors such as not being able to notice pedestrians when turning onto a side street, not stopping or yielding when signs indicate to do so, or to misreading road signs. This relationship could be explained considering the traffic context of Iran. There are ambiguities in traffic environment and enforcement in Iran. Poor infrastructure, low level of rule compliance and inconsistency with enforcement increases interpersonal conflicts which in turn may increase the likelihood of driving errors (Özkan et al., 2006; Tabibi et al., 2015). Further analysis of data indicated that, consistent with previous studies in Iran (Tabibi et al., 2015), driving errors was higher for crash-involved compared to crash free drivers. The crash-involved drivers reported higher scores in aggression, lack of emotional clarity and difficulty in engaging in goal-directed behaviour. These results may be in line with the proposition that conflicting situation of traffic in Iran may increase interpersonal conflicts specifically of those drivers with aggression trait and poor self-regulatory skills causing higher driving errors and crashes. How traffic context, aggression and emotion regulation interplay in driving errors and crashes requires further delineating studies. found that compared to Western/Northern European countries, Iranian drivers reported higher aggressive violations and errors. A high number of drivers (39%) in the current study reported to have experienced at least one crash in the previous year. This is consistent with epidemiological studies of the crash death rate in Iran (WHO, 2015), survey studies such as that of Tabibi et al. (2015) and Moghaddam et al., 2017 which all are indicative of the high risk of crash involvement in Iran. In the current study we measured any crash

whether minor or major and culpable or not. It would be informative that future directions tease apart severe vs minor, as well as culpable vs inculpable crashes.

With regard to attentional bias and driving errors, the results of partial correlations indicated that after adjusting for the classic Stroop interference score, the interference score of the emotional Stroop task remained significant for driving errors. Participants who took longer to name the colours of emotionally negative words than to name the colours of neutral words in negative emotion eliciting situations were those who reported more driving errors. Based on the assumption that the increased response time occurs because emotionally negative words require more attention than neutral words (Williams et al., 1996), those who take longer to respond in the emotional Stroop test are those who make more driving errors. This relationship remained significant in regression analysis, after accounting for the impact of the other variables in the model, including the Go/No-go task. Considering the fact that the attentional bias is the result of the effect of emotion on cognition, and its significant relation with driving errors might however, be consistent with findings indicating that emotional state affects driving performance (Hu et al., 2013; Pêcher et al., 2009). In their study Hu et al. (2013) induced negative emotion by video clips such as a video clip depicting some cases of traffic accident and tragic scenes after accidents. They found that negative emotional state influenced drivers' traffic-related cognition and behavior. While negative emotion successfully raised drivers' perception of traffic risk, it also lead to increased favourability of risky driving (attitude) and a tendency of risky driving behavior, including speeding (Hu et al., 2013). The effect of distraction caused by emotional state (attentional bias) on cognitive skills related to driving and driving performance is complicated and requires through and specific studies.

The result of the correlation and the regression model indicated that reaction time as measured by the Go/No-go task can predict driving errors. Those individuals with a poorer inhibitory control were more likely to report making more errors in driving. This is consistent with previous research (e.g., Tabibi et al., 2015), where among the three cognitive components of executive function, working memory, sustained attention and inhibition, inhibitory control was predictive of driving errors. Also, the result is consistent with the result of O'Brien and Gormley's (2013) study, which showed that compared to young driving non-offenders, offenders showed poorer inhibitory control as measured by the Go/No-go task (O'Brien and Gormley, 2013).

With respect to total score in DBQ anger and nervousness, obstinacy and revengeful the two components of aggression and difficulties in emotional regulation significantly predicted higher scores in risky driving behaviour, suggesting that aggression trait and the inability to regulate ones emotional state are important psychological factors in general risky driving behaviour.

Considering general aggression model (GAM), results indicate that various types of risky driving behaviour are influenced differently by different factors proposed by GAM. While, emotion regulation, aggression trait, inhibition, and attentional bias influenced driving errors, only aggression influenced driving violations. Nevertheless, aggression trait and emotion regulation influenced risky driving behaviour, in general.

Additionally, Tabibi et al. (2015) found that being male played a significant role in committing driving violations. The current study population was almost all male (89%) and male driver aggression was a significant factor for driving violations. Further study is required to elucidate the interaction between gender and aggression in driving violations.

4.1. Limitations and implications

There are limitations to this study. Drivers in the current study were primarily male, applicants for taxi driving positions, and had a wide range of ages and levels of driving experience. The experience of emotional state might be affected by this diversity. It is suggested that young people are more sensitive to emotionally invoked situations. Furthermore, gender, driving experience, how important driving is to the driver, and how much they enjoy it (driving motivation) affect emotional episodes experienced on the road. Therefore, we cannot be sure that all participants perceived the clips presented in the emotional Stroop test as negative, despite the pre-test. Gomez and Danuser (2007) indicated that it is necessary to make distinction between emotions that occur spontaneously and those that are induced by specially construed situations (here video clips). It is important to note that we used within-subject methodology to measure tendency toward attentional bias using the emotional Stroop task. Further studies could utilize a between-subjects methodology to study bias, where it is expected that one group of participants may display greater bias than another group of participants (e.g., aggressive drivers may show greater bias towards anger expressions than healthy control drivers). Moreover, the study would be greatly strengthened if measures of actual behavior (simulated driving task) were taken. Given that participants – were applicants for taxi driver positions – might have been motivated to portray their driving experiences in an overly positive light, and that in some way might limit the external validity of the results. Finally, the order of study task administration was not randomized. The computer tasks could have affected survey responses. However, it should be mentioned that the tasks were different in terms of the type and the content. The consistency of most results of the current study with that of previous studies may indicate a negligible effect.

Nevertheless, the results of the current study emphasized the strong role of aggression in a driver's decision to violate traffic rules and to evoke driving errors. The ability to regulate emotional state may, to some extent, increase resiliency to aggression when people are provoked to feel anger in traffic situations. It is plausible that strategies to control or neutralize one's anger could reduce the number of driving errors and crashes made in these types of driving situations.

However, other mediating factors need to be explored. Anderson and Bushman (2002) indicate that the relationship between anger experience and behavioral expression is moderated by cognitive appraisals. We postulate that the anxiety inducing traffic situation in Iran may trigger aggression more readily, making aggression a strong contributor to risky driving behavior. The interaction of situational traffic factors and personal predisposition to aggression warrants further examination. Moreover, the role of inhibitory control is once again called upon as a significant factor to lessen driving errors, emphasizing the importance of self-control for Iranian drivers. It also underscores the framework proposed by Reason et al. (1990) that driving errors are the function of information processing failures.

5. Conclusion

Aggression and difficulties in emotion regulation explained the higher frequency of risky driving behavior. Difficulties in emotion regulation, obstinacy and revengefulness, cognitive inhibitory control, and tendency toward attentional bias in the face of emotional stimuli explained the higher frequency of driving errors. The single factor of aggression, all its components, explained the higher frequency of driving violations. The results indicate that predisposition to aggression play an important role in committing various risky driving behaviors and crashes among applicants for taxi driving positions in Iran.

References

Özkan, T., Lajunen, T., Chliaoutakis El, J., Parker, D., Summala, H., 2006. Cross cultural differences in driving behaviors: a comparison of six countries. Transp. Res. Part F: Traffic Psychol. Behav. 9, 227–242. http://dx.doi.org/10.1016/j.trf.2006.01.002.

Anderson, C., Bushman, B., 2002. Human aggression. Annu. Rev. Psychol. 53, 27–51. http://dx.doi.org/10.1146/annurev.psych.53.100901.135231.

Aron, A.R., 2007. The neural basis of inhibition in cognitive control. Neuroscientists 13, 214–228. http://dx.doi.org/10.1177/1073858407299288.

Berkowitz, L., 1993. Aggression: Its Causes, Consequences, and Control. McGraw-Hill Book Company, New York.
Bertsch, K., Böhnke, R., Kruk, M., Naumann, E., 2009. Influence of aggression on information processing in the emotional Stroop task–an event-related potential study. Front. Behav. Neurosci. 3, 1–10. http://dx.doi.org/10.3389/neuro.08.028.2009.
Bond, M.H., 2004. Culture and Aggression—from context to coercion. Pers. Soc. Psychol. Rev. 8 (1), 62–78. http://dx.doi.org/10.1207/s15327957pspr0801_3.
Brodsky, W., 2002. The effects of music tempo on simulated driving performance and vehicular control. Transp. Res. Part F: Traffic Psychol. Behav. 4 (4), 219–241. http://dx.doi.org/10.1016/S1369-8478(01)00025-0.
Buss, A.H., Durkee, A., 1957. An inventory for assessing kinds of hostility. J. Consult. Psychol. 21 (4), 343–349.
Cattell, R.B., Eber, H.W., Tatsuoka, M.M., 1970. Handbook for the Sixteen Personality Factor Questionnaire (16PF). IPAT, Champaign, IL.
Cedrus-Corporation, 1999. SuperLab Pro SKD (Version 2.1) [Software]. Cedrus-Corporation, San Pedro: USA.
Chan, M., Singhal, A., 2013. The emotional side of cognitive distraction: implications for road safety. Accid. Anal. Prev. 50, 147–154. http://dx.doi.org/10.1016/j.aap.2012.04.004.
Cheng, A.S.K., Ng, T.C.K., Lee, H.C., 2012. Impulsive personality and risk-taking behavior in motorcycle traffic offenders: a matched controlled study. Personal. Individ. Diff. 53 (5), 597–602. http://dx.doi.org/10.1016/j.paid.2012.05.007.
Constantinou, E., Panayiotou, G., Konstantinou, N., Loutsiou-Ladda, A., Kapardis, A., 2011. Risky and aggressive driving in young adults: personality matters. Accid. Anal. Prev. 43, 1323–1331. http://dx.doi.org/10.1016/j.aap.2011.02.002.
Dahlen, E.R., Martin, R.C., Ragan, K., Kuhlman, M.M., 2005. Driving anger, sensation seeking, impulsiveness, and boredom proneness in the prediction of unsafe driving. Accid. Anal. Prev. 37, 341–348. http://dx.doi.org/10.1016/j.aap.2004.10.006.
DeWall, C.N., Finkel, E.J., Denson, T.F., 2011. Self-control inhibits aggression. Soc. Personal. Psychol. Comp. 5 (7), 458–472. http://dx.doi.org/10.1111/j. 1751-9004.2011.00363.
Deffenbacher, J.L., Lynch, R.S., Oetting, E.R., Swaim, R.C., 2002. The driving anger expression inventory: a measure of how people express their anger on the road. Behav. Res. Ther. 40, 717–737. http://dx.doi.org/10.1016/S0005-7967(01)00063-8.
Deffenbacher, J.L., Deffenbacher, D.M., Lynch, R.S., Richards, T.L., 2003. Anger, aggression, and risky behavior: a comparison of high and low anger drivers. Behav. Res. Ther. 41, 701–718. http://dx.doi.org/10.1016/S0005-7967(02)00046-3.
Denson, T.F., De Wall, C.N., Frinkel, E.J., 2012. Self-control and aggression. Curr. Direct. Psychol. Sci. 2 (1), 20–25. http://dx.doi.org/10.1177/0963721411429451.
Eckhardt, C., Cohen, D., 1997. Attention to anger-relevant and irrelevant stimuli following naturalistic insult. Personal. Individ. Diff. 239 (4), 619–629. http://dx.doi.org/10.1016/S0191-8869(97)00074-3.
Fadardi, J.S., Cox, W.M., 2005. Alcohol attention-control training programme. In: Paper Presented at 28 Th Annual Meeting of the Research Society on Alcoholism. Santa Barbara, USA.
Fadardi, J.S., Ziaee, S., 2010. A comparative study of drug–related attentional bias: evidence from Iran. Exp. Clin. Psychopharmacol. 18 (6), 539–545. http://dx.doi.org/10.1037/a0021559.
Galovski, T.E., Blanchard, E.B., 2004. Road rage: a domain for psychological intervention? Aggress. Violent Behav. 9, 105–127. http://dx.doi.org/10.1016/S1359-1789(02)00118-0.
Garrity, R.D., Demick, J., 2001. Relations among personality traits, mood states, and driving behaviors. J. Adult Dev. 8, 109–118. http://dx.doi.org/10.1023/a:1026446002317.
Gomez, P., Danuser, B., 2007. Relationships between musical structure and psychophysiological measures of emotion. Emotion 7 (2), 377–387. http://dx.doi.org/10.1037/1528-3542.7.2.377.
Gonzalez-Iglesias, B., Gomez-Fraguela, J., Luengo-Martin, M., 2012. Driving anger and traffic violations: gender differences. Transp. Res. Part F: Traffic Psychol. Behav. 15, 404–412. http://dx.doi.org/10.1016/j.trf.2012.03.002.
Gratz, K.L., Roemer, L., 2004. Multidimensional assessment of emotion regulation and dysregulation: development, factor structure, and initial validation of the difficulties in emotion regulation scale. J. Psychopathol. Behav. Assess. 26 (1), 41–54. http://dx.doi.org/10.1023/B:JOBA.0000007455.08539.94.
Hancock, G.M., Hancock, P.A., Janelle, C.M., 2012. The impact of emotions and predominant emotion regulation technique on driving performance. Work 41, 5882–5885. http://dx.doi.org/10.3233/WOR-2012-0666-3608.
Hu, T.-Y., Xie, X., Li, J., 2013. Negative or positive? The effect of emotion and mood on risky driving. Transp. Res. Part F: Traffic Psychol. Behav. 16, 29–40. http://dx.doi.org/10.1016/j.trf.2012.08.009.
Iversen, H., 2004. Risk-taking attitudes and risky driving behavior. Transp. Res. Part F: Traffic Psychol. Behav. 7, 135–150. http://dx.doi.org/10.1016/j.trf.2003.11.003.
Khanzadeh, M., Saidiyan, M., Hoseinchary, M., Edirisi, F., 2012. Factor structure and psychometric properties of difficulties in emotion regulation scale. J. Behav. Sci. 6 (1), 87–96 (Persian).
King, Y., Parker, D., 2008. Driving violations: aggression and perceived consensus. Eur. Rev. Appl. Psychol. 58, 43–49.
Lajunen, T., Parker, D., 2001. Are aggressive people aggressive drivers? A study of the relationship between self-reported general aggressiveness, driver anger and aggressive driving. Accid. Anal. Prev. 33, 243–255. http://dx.doi.org/10.1016/S0001-4575(00)00039-7.
Lajunen, T., Parker, D., Summala, H., 2004. The manchester driver behavior questionnaire: a cross-cultural study. Accid. Anal. Prev. 36 (2), 231–238. http://dx.doi.org/10.1016/S0001-4575(02)00152-5.
Lawton, R., Parker, D., Stradling, S.G., Manstead, A., 1997. Predicting road traffic accidents: the role of social deviance and violations. Br. J. Psychol. 88, 249–262. http://dx.doi.org/10.1111/j.2044-8295.1997. tb02633.x.
Magar, E.C.E., Phillips, L.H., Hosie, J.A., 2008. Self-regulation and risk-taking. Personal. Indiv. Differ. 45, 153–159. http://dx.doi.org/10.1016/j.paid.2008.03.014.
Marsh, H.W., Balla, J.R., McDonald, R.P., 1988. Goodness of fit indexes in confirmatory factor analysis: the effect of sample size. Psychol. Bull. 103, 391–410.
Mesken, J., Hagenzieker, M., Rothengatter, T., De Waard, D., 2007. Frequency, determinants and consequences of different drivers' emotions: an on- the −road study using self −report, (observed) behavior, and physiology. Transp. Res. Part F: Traffic Psychol. Behav. 10 (6), 458–475. http://dx.doi.org/10.1016/j.trf.2007.05.001.
Moeller, F.G., Barratt, E.S., Dougherty, D.M., Schmitz, J.M., Swann, A.C., 2001. Psychiatric aspects of impulsivity. Am. J. Psychiatry 158 (11), 1783–1793.
Moghaddam, A.M., Tabibi, Z., Sadeghi, S., Ayati, E., Ravandi, A.G., 2017. Screening out accident-prone Iranian drivers: are their at-fault accidents related to driving behavior? Transp. Res. Part F 46 (Part B), 451–461. http://dx.doi.org/10.1016/j.trf.2016.09.027.
Morooka, T., Ogino, T., Takeuchi, A., Hanafusa, K., Oka, M., Ohtsuka, Y., 2012. Relationships between the color-word matching Stroop task and the Go/No Go task: toward multifaceted assessment of attention and inhibition abilities of children. Acta Med. Okayama 66 (5), 377–386.
National Highway Traffic Safety Administration, 2010. Distracted Driving 2009. Traffic Safety Facts. DO DOT HS 811379US Department of Transportation, Washington.
Neale, V.L., Dingus, T.A., Klauer, S.G., Sudweeks, J., Goodman, M.J., 2005. An overview of the 100 car naturalistic study and findings. In: International Technical Conference on the Enhanced Safety of Vehicles (CD-ROM). Washington, DC : National Highway Traffic Safety Administration.
Nesbit, S., Conger, J., Conger, A., 2007. A quantitative of the relationship between anger and aggressive driving. Aggress. Violent Behav. 12 (2), 166–176. http://dx.doi.org/10.1016/j.avb.2006.09.003.
O'Brien, F., Gormley, M., 2013. The contribution of inhibitory deficits to dangerous driving among young people. Accid. Anal. Prev. 51, 238–242. http://dx.doi.org/10.1016/j.aap.2012.11.024.
Pêcher, C., Lemercier, C., Cellier, J., 2009. Emotions drive attention: effects on driver's behavior. Saf. Sci. 47, 1254–1259. http://dx.doi.org/10.1016/j.ssci.2009.03.011.
Parker, D., Reason, J.T., Manstead, A.R.S., Stradling, S.G., 1995. Driving errors, driving violations and accident involvement. Ergonomics 38 (5), 1036–1048. http://dx.doi.org/10.1080/00140139508925170.
Poó, F.M., Ledesma, R.D., 2012. A study on the relationship between personality and driving styles. Traffic Inj. Prev. 14 (4), 346–352. http://dx.doi.org/10.1080/15389588.2012.717729.
Pond Jr, R.S., Kashdan, T.B., DeWall, C.N., Savostyanova, A., Lambert, N.M., Fincham, F.D., 2012. Emotion differentiation moderates aggressive tendencies in angry people: a daily diary analysis. Emotion 12 (2), 326–337. http://dx.doi.org/10.1037/a0025762.
Reason, L., Nanstead, A., Strading, S., Bayter, J., Campbell, K., 1990. Errors and violations: a real distinction. Ergonomics 33, 1315–1332.
Rivers, S.E., Brackett, M.A., Omori, M., Sickler, C., Bertoli, M.C., Salovery, P., 2013. Emotion skills as a protective factor for risky behaviors among college students. J. Coll. Stud. Dev. 54 (2), 172–183. http://dx.doi.org/10.1353/csd.2013.0012.
Rizzo, M., Severson, J., Cremer, G., Price, K., 2003. An abstract virtual environment tool to assess decision-making in impaired drivers. In: Proceedings of the 2nd International Driving Symposium on Human Factors in Driver Assessment, Training and Vehicle Design. Iowa City: University of Iowa. pp. pp. 40–47.
Roberton, T., Daffern, M., Bucks, R., 2012. Emotion regulation and aggression. Aggress. Violent Behav. 17, 72–82. http://dx.doi.org/10.1016/j.avb.2011.09.006.
Roidl, E., Frehse, F., Höger, R., 2014. Emotional states of drivers and the impact on speed, acceleration and traffic violations-a simulator study. Accid. Anal. Prev. 70, 282–292. http://dx.doi.org/10.1016/j.aap.2014.04.010.
Salmon, P.M., Lenné, M.G., Stanton, N.A., Jenkins, D.P., Walker, G.H., 2010. Managing error on the open road: the contribution of human error models and methods. Saf. Sci. 48, 1225–1235.
Schreiber, L.R.N., Grant, J.E., Odlaug, B.L., 2012. Emotion regulation and impulsivity in young adults. J. Psychiatr. Res. 46 (5), 651–658. http://dx.doi.org/10.1016/j.jpsychires.2012.02.005.
Schwebel, D., Severson, J., Ball, K., Rizzo, M., 2006. Individual difference factors in risky driving: the roles of anger/hostility, conscientiousness, and sensation-seeking. Accid. Anal. Prev. 38 (4), 801–810. http://dx.doi.org/10.1016/j.aap.2006.02.004.
Smith, P., Waterman, M., 2003. Processing bias for aggression words in forensic and nonforensic samples. Cognit. Emotion 17 (5), 681–701. http://dx.doi.org/10.1080/02699930302281.
Smith, P., Waterman, M., 2005. Sex differences in processing aggression words using the emotional Stroop task. Aggress. Behav. 31, 271–282. http://dx.doi.org/10.1002/ab.20071.
Stanton, N.A., Salmon, P.M., 2009. Human error taxonomies applied to driving: a generic driver error taxonomy and its implications for intelligent transport systems. Saf. Sci. 47, 227–237.
Stavrinos, D., Garner, A.A., Franklin, C.A., Welburn, S.C., Johnson, H.D., Griffin, R., Underhill, A.T., Fine, P.R., 2015. Distracted driving in teens with and without attention-deficit/hyperactivity disorder. J. Pediatr. Nurs. 30, e183–191. http://dx.doi.org/10.1016/j.pedn.2015.04.006. (Special Issue: Health Care Transition for Adolescents and Emerging Adults with Special Health Care Needs and Disabilities).
Stephens, A.N., Groeger, J.A., 2009. Situational specificity of trait influences on drivers' evaluations and driving behavior. Transp. Res. Part F: Traffic Psychol. Behav. 12 (1), 29–39. http://dx.doi.org/10.1016/j.trf.2008.06.005.
Stephens, A.N., Groeger, J.A., 2011. Anger-congruent behavior transfers across driving situations. Cognit. Emotion 25, 1423–1438. http://dx.doi.org/10.1080/02699931.2010.551184.

Stephens, A., Trawley, S., Madigan, R., Groeger, J.A., 2012. Drivers display anger-congruent attention to potential traffic hazards. Appl. Cognit. Psychol. 27 (2), 178–189. http://dx.doi.org/10.1002/acp.2894.

Strayer, D.L., Johnston, W.A., 2001. Driven to distraction: dual-task studies of simulated driving and conversing on a cellular phone. Psychol. Sci. 12, 462–466. http://dx.doi.org/10.1111/1467-9280.00386.

Stutts, J., Feaganes, J., Reinfurt, D., Rodgman, E., Hamlett, C., Gish, K., Staplin, L., 2005. Driver's exposure to distractions in their natural driving environment. Accid. Anal. Prev. 37, 1093–1101. http://dx.doi.org/10.1016/j.aap.2005.06.007.

Tabibi, Z., Hashemi Borzabadi, H., Stavrinos, D., Mashhadi, A., 2015. Predicting aberrant driving behavior: the role of executive function. Transp. Res. Part F 34, 18–28. http://dx.doi.org/10.1016/j.trf.2015.07.015.

Thompson, A.L., Molina, B.S., Pelham, W., Gnagy, E.M., 2007. Risky driving in adolescents and young adults with childhood ADHD. J. Pediatr. Psychol. 32, 745–759. http://dx.doi.org/10.1093/jpepsy/jsm002.

Wickens, C.M., Toplak, M.E., Wiesenthal, D.L., 2008. Cognitive failures as predictors of driving errors, lapses, and violations. Accid. Anal. Prev. 40 (3), 1223–1233. http://dx.doi.org/10.1016/j.aap.2008.01.006.

Williams, J.M.G., Mathews, A., McLeod, C., 1996. The emotional Stroop task and psychopathology. Psychol. Bull. 120 (1), 3–24. http://dx.doi.org/10.1037/0033-2909.120.1.3.

World Health Organization, 2015. Iran (Islamic Republic Of): WHO Statistical Profile. http://www.who.int/gho/countries/irn.pdf?ua=1.

Zahedifar, Sh., Najarian, B., Shokrkan, H., 2000. Construction and validation for measurement of aggression. J. Educ. Sci. Psychol. Chamran Univ. Ahwaz 73–102 (Persian).

Zhang, Y., Kaber, D.B., Rogers, M., Liang, Y., Gangakhedkar, S., 2014. The effects of visual and cognitive distractions on operational and tactical driving behaviors. Hum. Factors 56, 592–604. http://dx.doi.org/10.1177/0018720813495279.