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Driving anger in Argentina

Gabriel Escanés[a,*], Fernando Martín Poó[b]

[a] Siglo 21 University, Calle de los Latinos N°8555 – B° Los Boulevares, 5008 Córdoba, Argentina
[b] Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)/Facultad de Psicología, Universidad Nacional de Mar del Plata, Funes 3250, Cuerpo V Nivel III, Alberti 4439 Dto. 2, Mar del Plata 7600, Argentina

ABSTRACT

Angry driving is a risk factor for traffic crashes and injuries, however it has been understudied in Latin American countries. The main aim of the present study was to translate and adapt the short form of the Driving Anger Scale (DAS; Deffenbacher et al., 1994) to the Argentinean Spanish. We also included further situations linked to bad conditions of the road network in Argentina. The sample of the study included 988 Argentinean drivers from the general population. Exploratory and confirmatory analysis supported a five-factor structure which were named as infringements by another driver (α = 0.91), progress impeded (α = 0.77), hostile gestures (α = 0.95), police presence (α = 0.67) and poor road infrastructure (α = 0.84). The DAS in the Argentinean driver's context obtained good psychometric indexes. We also found effects of gender, age, traffic violations and crash involvement on DAS and its subscales. Our findings are valuable as long as they provide information that has not been studied intensively in low and middle-income countries.

1. Introduction

From 2000 to 2011, car crash deaths in Argentina increased by 27%. By the end of that period, the annual mortality rate rose to 12.3 per 100,000 (Escanés, 2015). By 2013, the rate is estimated to have increased to 13.6 per 100,000. This is more than two times the rate in several high-income countries (World Health Organization, 2015). Furthermore, the risk of traffic death might have been underestimated due to the poor quality of vital statistics in Argentina (Ribotta and Escanés, 2014).

The risk of traffic death is due to environmental (e.g. road infrastructure), mechanical (e.g. vehicle condition) and human factors. It is estimated that human factors are involved in 95% of the collisions and the running over of pedestrians (Evans, 1996; Petridou and Moustaki, 2000). Human factors are linked to behavior, attitudes and emotions, among other things.

In terms of emotions, anger has been the most intensely studied (Deffenbacher, 2008; González-Iglesias et al., 2012; Gras et al., 2006). In general, anger emerges when a person perceives the presence of external obstacles which interfere with their own goals, plans or well-being. When people experience anger, they tend to eliminate environmental barriers and this increases the risk of serious injury or death, both for themselves and for other people (Reeve, 2014).

Although anger is a temporary emotional and physiological reaction, Deffenbacher et al. (1994) assumed that it was possible to study driving anger through the state-trait approach (Spielberger, 1988). According to this approach, it is possible to distinguish between the state of anger and trait anger. Whereas the state of anger is momentary and emerges as a response to a situation that is occurring, trait anger supposes an ever-present predisposition to experience anger. The greater the trait anger, the more predisposed individuals are to experience anger more often in a variety of situations, and the more intense the emotion, such that it results in greater negative social and personal consequences (Deffenbacher et al., 1996).

In the case of driving, the manifestation of trait anger is studied in a more constrained, well-defined context (Deffenbacher et al., 1994). As with trait-anger, drivers tend to feel driving anger to a greater or lesser degree, in a sustained manner and in several situations, all associated with driving a vehicle. Some studies show that when drivers experience more driving anger, there is a greater likelihood of exhibiting more aggressive and riskier behaviors (Bachoo et al., 2013; Stephens and Groeger, 2011). Consequently, these drivers have a higher chance of being involved in a car crash (Deffenbacher et al., 2003b; Dahlen and Ragan, 2004; Wickens et al., 2016).

Deffenbacher et al. (1994), developed the Driving Anger Scale to assess anger while driving. The DAS is a self-reporting measure that asks participants to imagine a set of driving situations and score the anger level that each circumstance elicits. The authors used cluster analysis techniques to select 33 items that have been grouped into six dimensions: "hostile gestures" (α = 0.87), "illegal driving" (α = 0.80),

* Corresponding author.
E-mail addresses: Gabriel.Escanes@ues21.edu.ar, gaescanes@gmail.com (G. Escanés), poo.fernando@conicet.gov.ar, poo.fernando@gmail.com (F.M. Poó).

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"police presence" (α = 0.79), "slow driving" (α = 0.81), "discourtesy" (α = 0.81) and "traffic obstructions" (α = 0.78). From these 33 items, researchers selected 14 items that were highly correlated with the total score and developed an abbreviated version (α = 0.80) (Deffenbacher et al., 1994). Both versions highly correlated with each other, and therefore either can be used to measure driver anger. The short scale can be applied more quickly as it also allows respondents to complete the survey in a faster, less tiring way.

The long version of the scale was later adapted for samples of drivers from different countries with mixed results. The DAS was used with samples of Spanish, Turkish, Malaysian and Chinese drivers. In these studies, the results confirmed the original six factor solution (Li et al., 2014; Sullman et al., 2007, 2014; Yasak and Esiyok, 2009).

Conversely, other studies revealed different factor structures. In The United Kingdom, Lajunen et al. (1998), found that the original model did not have a good fit. They reduced the scale to 21 items, grouped into three dimensions: "impeded progress by others" (α = 0.87), "reckless driving" (α = 0.88) and "direct hostility" (α = 0.87). Björklund (2008) applied the UK DAS to a sample of Swedish drivers. The results showed the same sources of anger registered in the UK, but there were some differences in the composition of each dimension. Sullman (2006) applied the DAS to New Zealand drivers and obtained a four-factor structure: "risky driving" (α = 0.86), "progress impeded" (α = 0.85), "discourteous driving" (α = 0.88) and "hostile gestures" (α = 0.88). In Ukraine, Stephens et al. (2016) applied the DAS to 339 drivers. Because the original model had a poor fit, 27 items were selected and grouped in a four-factor solution: "discourtesy" (α = 0.88), "impeded speed" (α = 0.80), "illegal driving" (α = 0.62) and "traffic congestion" (α = 0.82). Villieux and Delhomme (2007) adapted the DAS to French drivers. They excluded 11 items that did not meet the criterion to be retained for the analysis; the 22 remaining items were grouped in five categories: while "hostile gestures" (α = 0.80), "illegal driving" (α = 0.74) and "police presence" (α = 0.75) were maintained from the original version, the dimension of "discourtesy" was dropped and the factors "progress impeded" (α = 0.79) and "traffic obstructions" (α = 0.75) were modified.

Table 1 summarizes the dimensions found in different studies. Previous Spanish adaptations are included (Egea-Caparrós et al., 2012; Herrero-Fernández, 2011), as well as studies in which observed dimensions did not concur with the original study (Deffenbacher et al., 1994). Although the studies listed here represent only a fraction of the available literature, these studies indicate that consensus has not been reached. However, there are three repeated factors which are named in different ways by different authors: (1) hostile gestures, (2) illegal or risky driving, and (3) progress impeded (slow driving).

Adaptations of the DAS short form also revealed varying factor structures. Sullman and Stephens (2013) applied the short version of the DAS with New Zealand drivers. The results support the unidimensional model of the DAS (α = 0.86). The short version was also adapted in separate studies for use with two samples of Spanish drivers. On the one hand, research conducted in Bilbao by Herrero-Fernández (2011) revealed a three-factor solution: "impeded progress by others" (α = 0.77), "reckless driving" (α = 0.66) and "direct hostility" (α = 0.87). On the other hand, a study conducted in Murcia assessed three alternative models with one, three and four dimensions. Compared to the other two factor structures, the four-factor model showed the best fit for the data. The four dimensions were "progress impeded" (α = 0.76), "infringement by another driver" (α = 0.74), "direct offense" (α = 0.73) and "possible sanction" (α = 0.58) (Egea-Caparrós et al., 2012).

On the relationship between anger, sex and age, the results are heterogeneous. Some research studies revealed that the levels of driving anger between males and females were not entirely distinct from one another (Deffenbacher et al., 2003a, 2000; Herrero-Fernández, 2011; Lonczak et al., 2007). In contrast, other studies showed significant sex differences; specifically, women had higher scores on anger overall. Additionally, women scored higher than men in other factors, for instance in discourtesy, traffic obstructions, illegal driving, and risky driving (Egea-Caparrós et al., 2012; Sullman, 2006; Sullman et al., 2007).

In terms of differences by age, the results were also mixed. Some authors indicated that older drivers experienced a lesser degree of anger than younger drivers (Berdoulat et al., 2013; Dahlen et al., 2005; Parker et al., 2002; Przepiorka et al., 2014). Conversely, other studies found that there were no significant differences between age groups (Bachoo et al., 2013; Egea-Caparrós et al., 2012). These disparate findings could be due to the fact that, in some cases, participants were college students, while in others they were people from the general population. As a result, depending on the sample, different age ranges were used.

The empirical evidence gathered for the DAS, both for the short and long form, is inconclusive as to its factor structure, as well as its relationships with anger, sex and age. The lack of agreement could be due to various reasons. In some cases, it might be the result of methodological differences, such as using samples of diverse population groups and using diverse analysis techniques to determine factor structure or number of items to scale. In other cases, some researchers argue that it may be attributed to differences in the context and in the road safety culture of the country in which the study was conducted (Özkan et al., 2006; Stephens et al., 2016). The majority of studies that applied the DAS, however, were conducted in high-income countries (European or Anglo-Saxon).

Very few studies were conducted in low and middle-income countries (e.g. Dixit et al., 2011; Li et al., 2014). In Latin America, a study carried out in Brazil presents translated and linguistic adaptations of the DAS, but it does not provide empirical evidence as to its validity (Cantini et al., 2015). No DAS adaptation was found for the Argentine driving context. For this reason, the main aim of the present study was to translate and adapt the short scale of the DAS, Deffenbacher et al. (1994), into Argentine Spanish.

Because traffic conditions in Argentina differ from those of high income countries, we followed the suggestions made by Deffenbacher et al. (2016) and updated the scale. New situations, which were not included in the original version of the DAS, were added. Furthermore, we decided to keep the situations included in the original scale due to its full validity to measure driving anger. Traffic in Argentina is characterized by two main aspects: poor road infrastructure and a large vehicle fleet. On the first point, the Office of the National General Auditor (2013) indicated the existence of weaknesses in the road

Table 1
Dimensions of the DAS in different studies.

Authors	DAS dimensions					
Deffenbacher et al. (1994)	Hostile gestures	Illegal driving	Police presence	Slow driving	Discourtesy	Traffic obstructions
Lajunen et al. (1998)	Direct hostility	Reckless driving		Impeded progress by others		
Sullman (2006)	Hostile gestures	Risky driving		Progress impeded	Discorteous driving	
Stephens et al. (2016)		Illegal driving		Impeded speed	Discourtesy	Traffic congestion
Villieux and Delhomme (2007)	Hostile gestures	Illegal driving	Police presence	Progress impeded		Traffic obstructions
Herrero-Fernández (2011)	Direct hostility	Reckless driving		Impeded progress by others		
Egea-Caparrós et al. (2012)	Direct offense	Infringement by another driver	Possible sanction	Progress impeded		

network, such as surface damage on asphalt roads (e.g. bumps on the road), the lack of horizontal (painted on the roadway) and vertical (sign posts) signage and the improper operation of traffic signals (e.g. poorly timed traffic lights). On the second point, the number of motor vehicles in Argentina has nearly doubled in the past ten years, but there has been zero or limited improvement in traffic conditions (Ministry of Transportation. Road Observatory. Statistics Reports, 2014). Argentine drivers are thus exposed to traffic congestion and poor road conditions (e.g., speed bumps that are not signaled and potholes), which could damage the vehicle and trigger driver anger (Pau and Angius, 2001). Therefore, this study incorporated situations associated with road infrastructure. Consequently, the second aim of this study was to provide new evidence as to the validity and psychometric properties of the short scale of the DAS.

First, we presented the translated and adapted Argentine version of the DAS: (a) the factor structure was determined by exploratory factor analysis and confirmatory factor analysis, and (b) the scale's internal consistency was analyzed. Then, we considered the relationships between driving anger and: (a) sociodemographic variables such as sex and age; and (b) the driver's history of car crashes and traffic violations.

2. Method

2.1. Participants and procedure

The study was approved by the ethics committee of the Siglo 21 University. All participants were informed of the study's objectives. The anonymity and confidentiality of the data were guaranteed. Surveys were carried out among residents from the most populous cities in different geographical areas (Central region, Cuyo, Patagonia, Northeast and Northwest). The DAS was applied in the cities of Buenos Aires, Córdoba, Rosario, Comodoro Rivadavia, Corrientes, Mendoza and San Miguel de Tucumán. Participants were contacted by telephone and the average length of the calls was ten minutes. Participants were selected using probability sampling procedures, specifically, systematic sampling. The sampling population was obtained from telephone book listings that contain the full names and telephone numbers of the target population. Once telephone contact had been established, screening questions were used to identify drivers. If the person who answered the telephone did not satisfy the established sample criteria, another subject was selected from the telephone book listings. Of the 1250 drivers selected, 1052 participants responded to the questionnaire (response rate of 84%). Out of the 1052 respondents, 64 participants did not want to answer some questions of DAS. As a consequence, those data missing cases had been excluded from the study.

The sample consisted of motor vehicle drivers (512 males and 476 females = 988 total) between the ages of 18 and 60 (mean = 41.24, SD = 12.15). The driving experience of participants varied from less than 1 year to 47 years (mean = 19.27 years, SD = 12.54). Most respondents had at least a high school level education. With regard to frequency of car use, 54.6% of the drivers reported daily use, 39.4% noted that they drove several times a week, and the remaining respondents indicated that they drove less frequently. Finally, 30.8% of drivers were involved in a car crash or a pedestrian impact that caused injury within six months prior to the survey.

The sample was randomly divided into two sub-samples (Brown, 2006). Table 2 shows descriptive statistics for the samples used in the exploratory and confirmatory factor analyses. The composition EFA and CFA samples was similar.

Table 2
Descriptive statistics by demographic and driving variables in samples of exploratory and confirmatory factor analyses.

Demographic and driving variables	Sample EFA	Sample CFA
Age	Mean (SD)	Mean (SD)
18–30	25.14 (3.68)	24.51 (3.59)
31–45	38.25 (4.25)	38.58 (4.07)
46–60	53.29 (4.66)	53.54 (4.74)
Total	40.86 (12.00)	41.64 (12.32)
Sex	% (n)	% (n)
Male	51.6 (266)	52.1 (246)
Female	48.4 (250)	47.9 (226)
Education level		
Primary	2.7 (14)	2.7 (13)
Secondary	23.6 (122)	26.5 (125)
Tertiary	22.1 (114)	21.2 (100)
University	51.0 (263)	49.2 (232)
Driving Frequency		
Every day	54.1 (279)	55.1 (260)
Almost every day	23.8 (123)	20.8 (98)
Few days a week	16.1 (83)	18.0 (85)
Once a week or less	6.0 (31)	5.7 (27)
Years of driving experience		
10 or less	31.2 (159)	30.1 (140)
11–30	47.0 (239)	44.1 (205)
31 or more	21.8 (111)	25.8 (120)
Infringement committed over the past six months		
Yes	74.6 (385)	74.6 (352)
No	25.4 (131)	25.4 (120)
Crashes over the past six months		
Yes	29.1 (150)	32.6 (153)
No	70.9 (365)	67.4 (316)
Sampling size	52.2 (516)	47.8 (472)

2.2. Instruments

2.2.1. Demographic and driving questions

Participants completed a questionnaire that included questions on demographics and driving. The questionnaire included variables such as sex, age, education level, city of residence, driving frequency and number of years holding a driver's license. Additionally, participants were asked to report the accidents they had been involved in. Specifically, the following question was included in the survey: Were you involved in any car crash or pedestrian impact while driving in which someone was left injured over the past six months? (Yes/No). Furthermore, participants were asked if they had violated any of the following three traffic rules over the past six months: (a) speeding; (b) running a red light; and (c) failing to come to a complete stop at a stop sign. These three behaviors were selected because of the high level of risk they represent. The results to these questions are included in Table 2.

2.2.2. Driving anger scale (DAS) – short version

In the 14-item Driving Anger Scale, developed by Deffenbacher et al. (1994), participants are asked to reflect on the amount of anger triggered by certain traffic situations. These situations are assessed on a 5-point scale (1 = not at all; 2 = a little; 3 = some; 4 = much; 5 = very much), according to the anger level elicited. The short version was selected because it is the quickest form to measure anger while driving. The DAS adaptation followed the procedure of back translation. First, the original statements were translated from English to Spanish by an English language professor. These translations were then translated from Spanish back to English by another professional translator. The adaptations by Herrero-Fernández (2011) and Egea-Caparrós et al. (2012) were not used due to linguistic differences between Argentina and Spain.

We also added items that refer to Argentina's road infrastructure and that are not included in the original version of the DAS. These new items are based on previous qualitative studies, in which Argentine drivers shared their opinions about everyday traffic conditions. Participants provided feedback with respect to the following four scenarios: (a) traffic delays due to the lack of synchronized traffic lights;

Table 3
Factor structure and loadings of the 18-item DAS, mean and standard deviation in a sample of Argentine drivers.

No	Items	Factor loadings					Mean	S. D.	Item-test
		1	2	3	4	5			
	Infringements by other drivers								
8	Someone runs a red light at an intersection when the light for pedestrian is on	0.90					4.74	0.89	0.66
7	Someone backs out right in front of you without looking	0.81					4.53	0.77	0.64
6	Someone ahead of you is weaving in and out of traffic	0.77					4.30	1.08	0.56
10	A truck kicks up gravel on the car you are driving	0.40					4.39	1.02	0.54
9	Someone speeds up when you try to pass	0.40					3.93	1.22	0.42
	Progress impeded								
2	Someone who is parking very slowly may cause traffic congestion.		0.84				2.97	1.48	0.77
1	A slow vehicle on a mountainous road will not pull over to let people pass		0.59				3.39	1.55	0.77
5	You are driving behind a huge truck and it doesn't let you see ahead		0.58				3.34	1.36	0.50
3	You are stuck in a traffic jam		0.49				3.76	1.50	0.32
4	A cyclist riding in the middle of the lane is causing traffic to slow down		0.48				3.76	1.30	0.32
	Hostile gestures								
11	Someone makes an obscene gesture towards you about your driving			0.95			2.94	1.37	0.50
12	Someone honks at you about your driving			0.86			2.92	1.31	0.47
	Police presence								
13	You realize there is a speed trap as you drive at high speeds				0.86		2.86	1.27	0.50
14	A police officer pulls you over				0.58		1.97	1.40	0.49
	Poor road infrastructure								
15	Traffic delays due to the lack of synchronized traffic lights					0.72	3.89	1.12	0.63
17	Traffic delays due to a short green light					0.68	3.70	1.12	0.51
18	Hit speed bumps that are inadequately signed					0.60	4.22	0.98	0.45
16	Hit a pothole					0.56	4.31	0.98	0.55

(b) traffic delays due to a short green light; (c) hitting a speed bump that is not properly signaled; and (d) hitting a pothole. These new items were assessed by experts to ensure semantic clarity and consistency.

2.3. Data analysis

Data analysis was carried out using various procedures. First, descriptive statistics to measure the magnitude of anger while driving (means and standard deviations) were analyzed using SPSS version 23.0 (SPSS, 2014). Second, an exploratory factor analysis (EFA) was conducted using the software FACTOR 9.2 (Lorenzo-Seva and Ferrando, 2013). Unweighted Least Squares was used as a method for factor extraction, and parallel analysis (PA) was used as a procedure for determining the number of dimensions. Polychoric correlations were used because it is recommended when items are measured on an ordinal scale. In addition, this kind of correlations might improve the PA performance under conditions of skewness items (Timmerman and Lorenzo-Seva, 2011). Factors with eigenvalues higher than their corresponding 95th percentile eigenvalue derived from random data were retained. As the dimensions were correlated, oblique factor rotation was applied, using the Promin method. Third, confirmatory factor analysis (CFA) was used to assess the model fit in EFA using the AMOS 23 statistical package (Arbuckle, 2014). Finally, a Multivariate Analysis of Variance (MANOVA) was conducted to evaluate group differences.

Before conducting the EFA, the data were examined via Bartlett's test of sphericity and Kaiser–Meyer–Olkin (KMO) statistics. To ensure that the correlation matrix was adequate, the Bartlett's test of sphericity should be significant (p-value $< .05$) and the KMO index should be closer to one (Tabachnick and Fidell, 2013). The goodness of fit of the exploratory model was carried out using goodness of fit index (GFI) and root mean square of residuals (RMSR), bearing in mind Kelley's criterion (Byrne, 2016). Expected mean value of RMSR for an acceptable model was 0.0451. Moreover, two indices of factor simplicity were evaluated: Bentler's simplicity index (Bentler, 1977) and loading simplicity index (Lorenzo-Seva, 2003). The internal consistency of DAS-18 factors was assessed using the ordinal Cronbach alpha coefficient (Cronbach, 1951).

CFA was carried out using Structural Equation Models (SEM). Maximum Likelihood was used to estimate the size of the effects among the variables studied. As Weston and Gore (2006) suggested, the fit of the data was evaluated to determine if the relationships among the variables in the estimated model reflected the relations observed among the components of the DAS. We considered the chi squared coefficient (χ^2) and the ratio between chi squared and the degrees of freedom (χ^2/d.f.). The data is considered acceptable when the latter is less than 5 (Bentler, 1989). Additionally, the comparative fit index (CFI), goodness of fit index (GFI), the Tucker-Lewis index (TLI), Akaike information criterion (AIC) and the root mean square error of approximation (RMSEA) as well as its 90% Confidence Interval (C.I. 90%) were calculated. A good fit occurs when the CFI, GFI and TLI are greater than 0.90, the RMSEA shows values lower than 0.06 and the AIC shows the lowest score respectively (Hooper et al., 2008; Hu and Bentler, 1999; Schumacker and Lomax, 2012; Shah and Goldstein, 2006; Snipes and Taylor, 2014).

An analysis of bivariate correlations was conducted using Spearman's rho to assess the relationship between DAS dimensions and the demographic and driving variables (educational level, driving frequency, years of driving experience). Results were the criteria to include or exclude variables in the multivariate analysis.

Two MANOVA were carried out. First, differences in anger level in five factors found in factorial analysis by sex and age were assessed. Second, a MANOVA was conducted to assess whether there were statistically significant differences in two variables: those who were involved in car crashes compared with those who weren't, and those who violated traffic rules compared to those who didn't. In both cases, the factors were considered as independent variables, while the remaining ones were considered as fixed factors.

Finally, two logistic regressions were carried out to analyze associations between DAS scores and car crashes, on the one side; and DAS scores and traffic violations, on the other. DAS factors were considered as independent variables.

3. Results

3.1. Exploratory factor analysis

An exploratory factor analysis was applied on the 18-item version of the DAS in order to determine the factor structure (KMO = 0.840; Bartlett Test = 2648.8, p < .001; GFI = 0.99; RMSR = 0.029; Kelley's criterion = 0.0449; Bentler's simplicity index = 0.9825; loading simplicity index = 0.5862). Factor solution was theoretically interpretable. Parallel analysis was conducted using the software FACTOR 9.2 and found five factors that surpassed the PA criterion, which explained 66% of the total variance. As factor loadings were over 0.35, all items were included (see Table 3).

The DAS total scale scores demonstrated good internal consistency (α = 0.84). The first factor explained 35% of the variance and consisted of five items which referred to the anger experienced due to violations of traffic rules committed by other drivers. This dimension was named *infringements by other drivers* (α = 0.91). The second factor explained 11% of the variance and included four items linked to situations in which a driver had difficulties maneuvering as a result of the behavior of other drivers. Therefore, this factor was labeled *progress impeded* (α = 0.77). Factor 3, named *hostile gestures* (α = 0.95), accounted for 7% of the variance. This dimension included two items which involved direct offensive gestures or behaviors from other drivers. The fourth factor explained 7% of the variance and grouped two items which referred to the chances of being penalized by transit control. This factor was called *police presence* (α = 0.67). The fifth factor explained 6% of the variance and included four items associated with road infrastructure. As a result, this dimension was labeled *poor road infrastructure* (α = 0.84).

Table 3 shows the descriptive statistics for the 18-item DAS (mean, standard deviations) and corrected item-test correlations; the latter were all over 0.35 (mostly from moderate to high), which indicates good discrimination indices.

3.2. Confirmatory factor analysis

Table 4 summarizes the model fit for one, three and five factors. Firstly, the evaluated indices indicate that the unidimensional model did not adequately fit the data, which suggests that the construct "driving anger" includes more than one dimension. Secondly, the 3-factor model only had a good fit on the ratio between chi squared and the degrees of freedom criterion. Finally, the 5-factor model, resulting from the exploratory factor analysis, presented the best fit indicators.

Fig. 1 shows the 18-item five-factor model and shows the correlations among the different situations of driving anger. All dimensions were positively correlated with each other. Correlations were low to moderate. Item regression coefficients showed good factor loadings (values over 0.46). Table 5 shows the composite reliability for each factor.

3.3. Spearman's rho correlations

Spearman's rho was used to analyze correlations between the five DAS dimensions and the variables educational level, driving frequency, and years of driving experience. Significant correlations were not found. The correlation coefficients were as follows: (1) for educational levels, 0.00–0.03; (2) for driving frequency, 0.01–0.04; and also (3) for driving experience, 0.02–0.07. Because relationships between these variables and the dimensions of the DAS were not found, these variables were omitted from the multivariate analyses.

3.4. Differences in driver subgroups

According to the MANOVA, there were differences in DAS scores by sex, age group, traffic violations and involvement in crashes. Additionally, there was no interaction effect between sex and age. Table 6 shows the effect size analysis using Cohen's (1988) criteria. In terms of the variables analyzed, all effect sizes were small.

In terms of sex, the ANOVA indicated differences in the *progress impeded* subscale and the *hostile gestures* subscale. In both cases, women obtained higher means than men. Furthermore, there were differences by age group in two subscales: *progress impeded* and *police presence*. In the first case, older drivers had higher scores (46–60 years), followed by younger drivers (18–30 years) and, finally, middle-aged drivers (31–45 years). Pairwise comparisons with Bonferroni's adjustment revealed significant differences between middle-aged drivers and older drivers, but not between other age groups. The same pattern was repeated on the DAS *police presence* subscale. Older drivers scored highest, followed by younger drivers and, finally, middle-aged drivers. In this case, pairwise comparisons with Bonferroni's adjustment also revealed significant differences only between middle-aged drivers and older drivers.

In terms of traffic violations, there were differences on two DAS subscales: *infringements by other drivers* and *police presence*. In both cases, drivers that had violated traffic rules scored higher compared with those who complied with traffic regulations. Finally, the ANOVA showed differences by involvement in crashes in two DAS subscales: *infringements by other drivers* and *progress impeded*. In both DAS subscales, drivers who were not involved in crashes had higher scores compared to drivers who had crashed (see Table 7).

3.5. Regression analysis

Two logistic regressions were conducted to analyze the relationships between the DAS dimensions and, infractions and car crashes respectively (see Table 8). In the first logistic regression (Hosmer and Lemeshow goodness of fit test: χ^2 (8) = 9.899, p = .272. Omnibus test: χ^2 (5) = 18.407, p < .01.), significant relationships were observed for *Infringement by other drivers* aOR = 1.076, p < .01, 95% CI (1.018; 1.136) and *Police presence* aOR = 1.170 p < .01, 95% CI (1.069; 1.280). On the one hand, drivers, who experienced anger due to violations of traffic rules committed by other drivers, were more likely to violate the norms than those who did not feel anger in this kind of situations. On the other hand, those who experienced anger as a result of police control were more likely to violate the norms than those who did not feel anger in this kind of circumstances. In the second logistic regression (Hosmer and Lemeshow goodness of fit test: χ^2 (8) = 13.106, p = .108. Omnibus test: χ^2 (5) = 5.973, p = .309), significant relationships were not found for any of the dimensions.

4. Discussion

DAS is the most widely used instrument to assess driving anger, but

Table 4
Goodness-of-fit indices for the CFA models - 18-item DAS.

Model	χ2	D.F.	χ^2/D.F.	CFI	GFI	TLI	RMSEA [C.I. 90%]	AIC
One Factor	1074.847	135	7.961	0.629	0.792	0.579	0.119 [0.115, 0.123]	1146.847
Three Factors	540.203	132	4.092	0.839	0.886	0.813	0.079 [0.075, 0.083]	618.203
Five Factors	340.393	125	2.723	0.915	0.928	0.896	0.059 [0.055, 0.063]	432.393

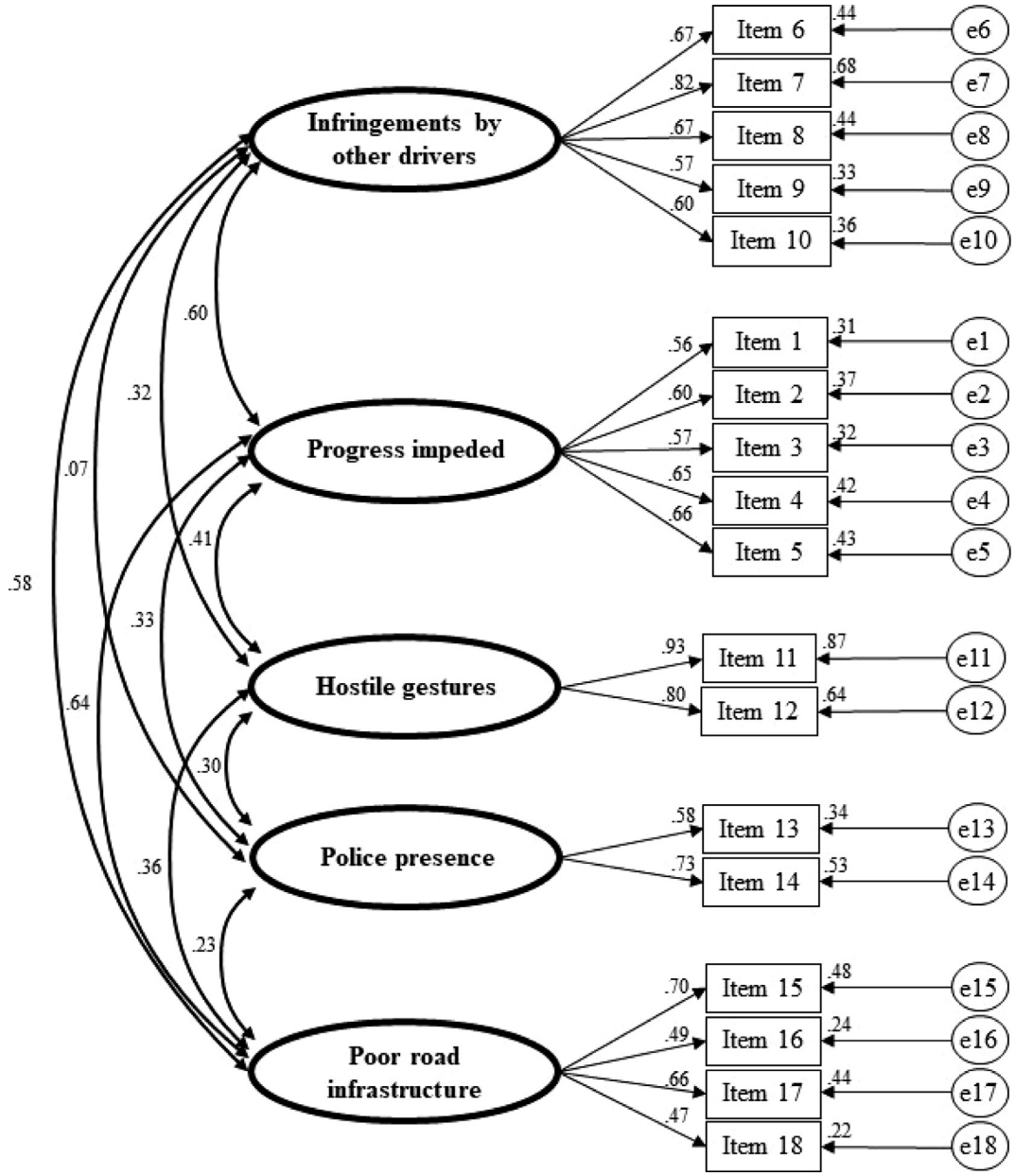

Fig. 1. Confirmatory factor analysis model for 18-item Driving Anger Scale (DAS).

Table 5
Composite reliability values.

Factor	C.R.
F1: Infringements by other drivers	0.8
F2: Progress impeded	0.8
F3: Hostile gestures	0.7
F4: Police presence	0.7
F5: Poor road infrastructure	0.8

Table 6
Multivariate test.

	Pillai's trace	F	Hypothesis df	Error df	*p*	η^2
Sex	0.025	5.062	5	978	0.000	0.025
Age	0.022	2.191	10	1958	0.016	0.011
Sex * Age	0.007	0.655	10	1958	0.767	0.003
Traffic violations	0.018	3.514	5	976	0.004	0.018
Involvement in crashes	0.016	3.252	5	976	0.006	0.016

there is very little evidence of its validity in low- and middle-income countries, such as the countries of Latin America. This study provides evidence of the psychometric properties of the 18-item DAS in Argentine drivers.

The findings indicated that the five-factor structure provided a good fit. The solution supports the four-dimension model found in Spain by Egea-Caparrós et al. (2012), even with this study's incorporation of a new dimension, *poor road infrastructure*, which was not included in the original version of the DAS. The new factor refers to situations associated with the poor conditions that are prevalent on Argentine roadways, a problem common to countries that are less economically developed. Such conditions can lead to vehicle damage, sudden maneuvering and traffic delays; these contribute to driving anger.

The factor solution obtained in this study differs from the findings of previous studies conducted in the United States, Spain and New Zealand (Deffenbacher et al., 1994; Herrero-Fernández, 2011; Sullman and

Table 7
Tests of between-subjects effects, means and confidence interval.

		Infringements by other drivers	Progress impeded	Hostile gestures	Police presence	Poor road infrastructure
Sex	F (df)	3.771 (1)	17.531 (1)	13.447 (1)	0.332 (1)	3.043 (1)
	p	0.052	0.000[a]	0.000[a]	0.565	0.081
	η^2	0.004	0.018	0.014	0.000	0.003
Male	Mean	21.491	16.455	5.600	4.778	15.718
	Lower bound	21.162	16.052	5.356	4.577	15.446
	Upper bound	21.820	16.858	5.844	4.980	15.990
Female	Mean	21.969	17.718	6.270	4.865	16.073
	Lower bound	21.615	17.285	6.007	4.648	15.780
	Upper bound	22.322	18.152	6.532	5.082	16.365
Age	F (df)	1.509 (2)	3.608 (2)	1.520 (2)	3.413 (2)	2.036 (2)
	p	0.222	0.027[b]	0.219	0.033[b]	0.131
	η^2	0.003	0.007	0.003	0.007	0.004
18–30	Mean	21.832	16.893	6.084	4.917	15.600
	Lower bound	21.351	16.304	5.728	4.622	15.203
	Upper bound	22.312	17.481	6.441	5.211	15.997
31–45	Mean	21.448	16.759	5.715	4.562	15.978
	Lower bound	21.049	16.269	5.418	4.317	15.648
	Upper bound	21.847	17.248	6.011	4.807	16.308
46–60	Mean	21.910	17.609	6.005	4.988	16.109
	Lower bound	21.543	17.160	5.733	4.763	15.806
	Upper bound	22.276	18.058	6.277	5.212	16.412
Traffic Violations	F (df)	8.108 (1)	1.262 (1)	1.854 (1)	7.817 (1)	0.074 (1)
	p	0.004[b]	0.262	0.174	0.005[b]	0.785
	η^2	0.008	0.001	0.002	0.008	0.000
Yes	Mean	21.792	17.116	5.961	4.937	15.948
	Lower bound	21.518	16.776	5.757	4.769	15.721
	Upper bound	22.065	17.457	6.166	5.105	16.175
No	Mean	20.719	16.591	5.578	4.291	15.863
	Lower bound	20.032	15.737	5.065	3.870	15.292
	Upper bound	21.406	17.444	6.091	4.712	16.433
Involvement in crashes	F (df)	5.164 (1)	4.070 (1)	2.600 (1)	1.828 (1)	0.158 (1)
	p	0.023[b]	0.044[b]	0.107	0.177	0.691
	η^2	0.005	0.004	0.003	0.002	0.000
Yes	Mean	20.827	16.381	5.543	4.770	15.967
	Lower bound	20.215	15.621	5.085	4.395	15.459
	Upper bound	21.439	17.142	6.000	5.146	16.476
No	Mean	21.683	17.326	5.996	4.458	15.843
	Lower bound	21.269	16.811	5.687	4.204	15.499
	Upper bound	22.098	17.841	6.306	4.712	16.188

Note: Confidence Interval 95%.
[a] $p < .001$.
[b] $p < .05$.

Table 8
Binary logistic regressions between DAS dimensions, car crashes and traffic infractions.

DAS dimensions	Traffic infractions		Crashes	
	OR	IC 95%	OR	IC 95%
Infringement by other drivers	1.076 (p < .01)	1.018; 1.136	0.971 (p = .17)	0.930; 1.013
Progress impeded	0.977 (p = .35)	0.931; 1.026	0.975 (p = .17)	0.941; 1.011
Hostile gestures	0.981 (p = .60)	0.914; 1.054	1.001 (p = .69)	0.959; 1.065
Police presence	1.170 (p < .01)	1.069; 1.280	1.033 (p = .30)	0.971; 1.099
Poor road infrastructure	0.964 (p = .30)	0.96; 1.112	1.030 (p = .27)	0.977; 1.087

Stephens, 2013). However, this study found satisfactory psychometric evidence for the 18-item DAS. Factor loadings of items were high and discrimination indices were good. The internal consistency obtained was satisfactory both for the overall DAS and for each dimension. With regard to relationship between DAS dimensions, positive covariances with low to moderate intensity were observed. Higher covariances were found between progress impeded and poor road infrastructure (0.64), and between infringement by other drivers and progress impeded (0.60). The lowest covariance was observed between infringement by other drivers and police presence (0.07). These results indicated that dimensions were associated to each other.

In this study, the overall driving anger score was higher than it was in previous studies conducted with drivers in Spain (Murcia M = 43.2; Bilbao M = 42.8) and New Zealand (M = 38.2) (Egea-Caparrós et al., 2012; Herrero-Fernández, 2011; Sullman and Stephens, 2013). Specifically, the anger levels associated with infringement by other drivers and progress impeded were higher among the sample of Argentine drivers compared to their Spanish counterparts, but Argentine anger levels were lower with respect to hostile gestures and police presence. Compared to the New Zealand sample, Argentine drivers scored lower in anger in only one item: someone making an obscene gesture towards you about your driving.

Considering each of the 18 assessed situations, the highest levels of driving anger were triggered from two circumstances: “someone runs a

red light at an intersection when the light signals a pedestrian right of way" and "someone backs out right in front of you without looking". When drivers engage in these behaviors, the risk of injury or deaths is increased, both for those who commit this negligence as well as for other road users. The perception of the consequences could be one of the causes of driving anger. With regard to the situations that elicited the lowest levels of driving anger, Argentine drivers indicated that these are associated with the police presence factor. This result coincides with the research conducted in New Zealand (Sullman and Stephens, 2013).

Similarities and differences were analyzed to assess driver anger between men and women, and among varying age groups. The female level of driving anger was higher than in males in two kinds of situations: (a) when the driver was forced to stop or to reduce speed because of another driver's behavior; and (b) when another driver made offensive gestures. Probably, female drivers have different levels of rule awareness than males do and the former interpreted that these situations are not as they should be. In the first case, anger might be due to restriction perceived as illegitimate and unfair, while in the other case, it might result from maltreatment or violent acts between drivers. Both imply interactions with other drivers, difficulties in traffic and the lack of respect from other drivers. According to Merlino et al. (2011), in the Argentine culture, which is characterized as a patriarchal society, driving car is mainly associated with masculine attributes and women are viewed as foreign by the car. From that point of view, machismo has a crucial role in the formation of prejudices toward women, who could feel some discomfort due to inappropriate gestures or behaviors from other drivers.

Results show that older drivers (46–60 years) were more likely to experience higher levels of anger in two types of situations: on the one hand, those related to progress impeded and, on the other hand, those linked to police presence. Both circumstances could be perceived as illegitimate coercion that forces them to alter their driving style. From that perspective, coercive behaviors cause inconveniences (e.g. a delay to reach the destination or greater driving difficulties) which is detrimental to the personal goal. Thus, older people might have little tolerance to drive in the Argentine driving context. In these same situations, younger drivers (18–30 years) were more likely to experience intermediate levels anger, while drivers aged 31–45 years reported the lowest levels of driving anger. These findings contrast with the findings of previous studies, which indicate that older drivers tend to experience less anger while driving (Berdoulat et al., 2013; Dahlen et al., 2005; Parker et al., 2002; Przepiorka et al., 2014). Furthermore, these results contrast with those in studies that found no significant differences between age groups (Bachoo et al., 2013; Egea-Caparrós et al., 2012). It seems probable that the variables that were not incorporated and analyzed could be affecting this study's findings. However, we need to keep in mind that the studies mentioned above define age groups in different ways.

When differences in DAS scores by car crash history were analyzed through MANOVA, those drivers who had not crashed during the six months prior to the survey reported higher scores compared to those drivers that were actually involved in a car crash. Situations that triggered more anger among these drivers were linked to infringements by other drivers and progress impeded. These findings conflict with those of previous studies which showed that the higher the level of driving anger, the more likely the driver is to be involved in a car crash (Dahlen and Ragan, 2004; Deffenbacher et al., 2003b; Wickens et al., 2016). Again, our results are difficult to interpret. Nevertheless, considering the infringements-by-other-drivers subscale, it can be assumed that drivers who have not crashed would experience more anger as a result of reckless behavior by another driver. Regarding the progress impeded subscale, this might be because the relationship between anger and crash involvement may be mediated by the driver's rush or anxiety to get somewhere. Regression analysis did not show correlations between the DAS subscales and traffic crashes.

With respect to traffic violations, significant differences were observed in the degree of anger. Drivers that violated traffic norms reported a greater likelihood of experiencing anger in two subscales: police presence and infringements by other drivers. These results were consistent through MANOVA and logistic regression analyses. On the one hand, this may be because those who violate regulations perceive a higher likelihood of being fined, and consequently have a more negative view of police control. On the other hand, the differences in driving anger could be explained by varying interpretations of non-compliance with traffic norms. Results from earlier studies suggested that drivers were more benevolent when they assessed their own infringements than when they evaluated infringements committed by other drivers (King and Parker, 2008; Warner and Åberg, 2014).

Elvik (2011), proposed an analytical model for the development and implementation of public policies in road safety. According to this author, the traffic psychology perspective may contribute in the detection of risk factors (for example, human behavior), the developments in road safety objectives and the identification, implementation and evaluation of potentially effective measures. Given that different vehicle driving behavior can lead to unequal consequences, it is useful to take into account valid instruments that allow us to understand such differences.

It would be wrong to suppose that all behavior will have the same consequences, that drivers are a homogeneous group or that research findings are generalizable in different contexts. The current article provides a useful tool for the detection of road safety risk factors and the evaluation of changes in behavior occurring after the implementation of public policies. However, beyond its potential usefulness, it is important to point out that decision makers seldom rely on the knowledge that emerges from scientific research, especially in the Argentine context. Nevertheless, researchers should commit themselves to disseminate their findings to the general public and to establish communication channels with decision makers.

The adaptation of the 18-item DAS in the Argentine context obtained good psychometric indices and provided evidence of discrimination among road user groups. These findings are valuable in as much as they provide information about a global problem that has not been widely studied in low- and middle-income countries. In addition, it is the belief of the authors that the newly incorporated factor is an important contribution which reflects a problem that is typical of these kinds of countries. It is crucial to the understanding of different road cultures to include specific contextual aspects such as this (Özkan and Lajunen, 2011).

The results also made it possible to discriminate between driver groups based on their degree of anger. Although some of this study's findings run counter to the findings of previous studies, they contribute knowledge necessary to understanding the expression of driver anger.

Finally, a notable strength of this study is linked with the sample. The size of the sample and the use of probability sampling procedures to select people from the general population are very beneficial.

5. Study limitations

Our study has some limitations that should be taken into account by road rage researchers. Firstly, three or more items are recommended for factors but, exploratory factor analysis in this work indicates that only two dimensions had two items each (hostile gestures and police presence). Both dimensions had the same number of items in previous research conducted by Egea-Caparrós et al. (2012). In addition, this study found satisfactory psychometric evidence for all dimensions. It is important that future research is improved in this area.

Secondly, some of our results about differences by sex, were consistent with the findings of some previous studies (Egea-Caparrós et al., 2012; Sullman, 2006; Sullman et al., 2007). However, other research indicated different results (; Deffenbacher et al., 2003a, 2000; Herrero-Fernández, 2011; Lonczak et al., 2007). The lack of consensus in this regard points to the need for further research to obtain robust findings.

Thirdly, selected participants were residents of Argentina's most

populous cities and, as a consequence, the degree of anger remains unknown for drivers in less densely populated areas. Additionally, participants in this study were selected from telephone book listings, and as a result anger was not measured for drivers who do not have a landline. According to a national survey conducted in 2015, 37.6% of households in Argentina had no landlines (INDEC, 2015).

Finally, the questionnaire did not assess social desirability biases, and therefore, future research will need to assess and control potential distorted responses. There is no doubt that further research should be conducted, especially cross-cultural research that allows for comparisons between countries and, thus, avoids methodological differences.

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