



# Adaptation of the multidimensional driving styles inventory for Spanish drivers: Convergent and predictive validity evidence for detecting safe and unsafe driving styles

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## ARTICLE INFO

### Keywords:

Driving styles  
Spanish  
MDSI  
Safe drivers  
Reckless driving  
Distractive  
Angry  
Anxious  
Careful  
Patient  
Stress reduction

## ABSTRACT

The *Multidimensional Driving Style Inventory* (MDSI; Taubman – Ben-Ari et al., 2004) is a well-known and useful instrument that allows us to identify not only “maladaptive” Driving Styles (DS) in order to modify them, but also “adaptive” DS to encourage safe driving. The aim of this study was to adapt the MDSI to the Spanish spoken in Spain and to the rules and driving habits of Spaniards. The Argentinian version of the MDSI was taken as the source version. The sample consisted of 1173 drivers, who completed the Spanish version of the MDSI. The factor structure was analysed by means of an Exploratory Factor Analysis (AFE) and a Confirmatory Factor Analysis (AFC). The 6-factor structure of the Argentinian version of the MDSI was replicated with higher internal consistency values for each of the DS. The original Argentinian and the Spanish versions share 23 items, indicating a relevant overlap in the construct. A cluster analysis grouped the DS into two groups: maladaptive and adaptive. Significant associations were found between DS measures and demographic variables (gender, age, and education level), driving history and theoretically related constructs like the Domain-Specific Risk-Taking Scale (DOSPERT); Lapses, Errors, Violations; Angry Driving; and Sensitivity to Rewards. The Spanish MDSI provides valid measures that could help us understand complex driving behaviours and promote safe driving.

## 1. Introduction

Driving performance depends not only on the driver's skills but also on the degree of risk he or she is willing to assume (Elander et al., 1993; McKenna et al., 2006). Driving competence, which may reflect different Driving Styles (DS) can be improved by training (Castro et al., 2016; Crundall, 2016), and targeted interventions can redress the under-estimation of risk and risky decision-making. The identification of DS can be carried out by using assessment instruments like the *Multidimensional Driving Style Inventory* (MDSI). The MDSI was developed by Taubman – Ben-Ari and her colleagues in 2004 to detect distinct DS, including not only “maladaptive styles” (e.g., Reckless, Angry, Anxious and Dissociative) but also some more adaptive styles like the Careful driving style.

This study presents a version of the MDSI adapted and validated for the Spanish spoken in Spain, taking into account the cultural context, traffic rules and driving habits of Spanish drivers. The *Guidelines for Translating and Adapting Tests* of the International Test Commission

(International Test Commission, ITC, 2001) establishes that the adaptation of a questionnaire should consider linguistic, psychological and cultural differences between the populations of interest besides providing validity evidence for the adapted versions. Well-known differences in language, culture and driving habits between Spain and Argentina justify the adaptation and validation of the MDSI in Spain. For example, a recent international road report (IRTAD, 2018) shows that in 2014 the ratio of deaths per 10,000 vehicles was 2.6 in Argentina and 0.5 in Spain; the seatbelt wearing rates in front seats in Spain was 90 % whereas in Argentina it was only 50 %, and in rear seats in Spain was 81 % whereas in Argentina it was only 23 %. In 2004, it was also estimated that in Argentina, road deaths caused by the consumption of alcohol were 24 % and in Spain 26 %, while the consumption of drugs caused 22.5 % and 13 % of deaths on the road in Argentina and Spain, respectively (IRTAD, 2017).

The adaptation of the MDSI to the Spanish spoken in Spain takes the Argentinian MDSI developed by Poó et al. (2013) as the source version. The Argentinian MDSI consists of 40 items, 27 from the original MDSI

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<https://doi.org/10.1016/j.aap.2019.105413>

Received 11 January 2019; Received in revised form 1 December 2019; Accepted 23 December 2019

Available online 31 December 2019

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and 13 new items developed to adapt the instrument to the culture, regulations and driving habits in Argentina. Exploratory factor analysis results allowed identifying six factors that account for 46.9 % of the total variance: Reckless, Angry, Anxious, Distress reduction, Careful and Dissociative. The Argentinian MDSI showed adequate internal consistency (Cronbach’s alpha) for each factor, this varying from 0.59 to .88.

Research on the psychometric properties of the MDSI measures has provided solid validity evidence. This body of research has been summarised in an extensive review of a decade of studies using the MDSI (Taubman – Ben-Ari and Skvirsky, 2016). In the last decade, the MDSI has been translated into various languages (English, Italian, Russian and Arabic), culturally adapted to Romania (Holman and Havârneanu, 2015) and Argentina and to the Spanish spoken there (Poó et al., 2013). The MDSI, along with its different adaptations, has been widely tested in different countries such as the Netherlands and Belgium in Europe, and China and Malaysia in Asia (Hooft van Huysduynen et al., 2015; Karjanto et al., 2017; Long and Ruosong, 2019). A cross-cultural comparison of the MDSI between Israel and Australia provided additional evidence for its robustness (Skvirsky et al., 2017). Taken together, these findings contribute to efforts to promote worldwide policies aimed at providing measures that can help identify maladaptive DS and foster adaptive DS.

The main objective of the study was to adapt the MDSI to the Spanish spoken in Spain and the cultural context, regulations and driving habits of Spanish drivers. Our aim was to provide validity evidence of the dimensionality of the adapted version of the MDSI in Spain and compare it with the Argentinian version obtained by Poó et al. (2013). We also analysed the relationship of the DS measures with some demographic variables (age, gender and educational level), as well as the reported involvement in road accidents and repeated traffic infractions. Finally, as a pioneering contribution, we sought to obtain evidence of relations to other variables by exploring the associations between the MDSI measures and different driving variables that had not been previously examined. Specifically, we analysed the relations of the DS of the MDSI with: (1) measures of Lapses, Errors and Violations, by means of the DBQ (The Driver Behaviour Questionnaire; Reason et al., 1990); (2) measures of driving anger obtained by means of the DAS (Spanish Anger Driving Scale, Deffenbacher et al. (1994); (3) measures of hazard perception in different contexts (leisure, finance, health, social) by means of the Domain-Specific Risk-Taking Scale (DOSPERT, Blais and Weber, 2006), (4) measures of sensitivity to punishment and reward used by the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia et al., 2001); and (5) diagnostics of alcohol consumption by means of the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993).

## 2. Preliminary preparations

The goal of this research first step was to obtain evidence of the appropriateness of the Argentinian version of the MDSI (Poó et al., 2013) to the Spanish spoken in Spain and the context, regulations and driving habits of Spanish drivers.

### 2.1. Method

#### 2.1.1. Participants and procedure

Three experts with more than twenty years of experience in the field of road safety were recruited from different universities and research centres.

These experts were asked to evaluate whether the instructions, item stems and response options were suitable for Spanish culture, language and driving habits. Experts used a template with a 5-point Likert-type scale ranging from 1 (“not suitable at all”) to 5 (“very suitable”). If the expert’s rating was 4 or less, we asked the experts to identify the inappropriate words, expressions, etc., and propose alternative wordings.

**Table 1**

Descriptive statistics for the experts’ evaluations.

Item	M	SD	Median	Item	M	SD	Median
1	2.67	1.15	2.00	21	5.00	0.00	5.00
2	5.00	0.00	5.00	22	4.50	.58	4.50
3	2.00	0.00	2.00	23	4.67	.58	4.00
4	4.00	1.00	4.00	24	3.33	.58	3.00
5	3.33	.58	3.00	25	5.00	0.00	5.00
6	2.33	.58	2.00	26	3.67	.58	4.00
7	2.33	.58	2.00	27	5.00	0.00	5.00
8	3.00	1.00	3.00	28	4.67	.58	4.00
9	2.33	1.15	3.00	29	3.67	.58	4.00
10	5.00	0.00	5.00	30	5.00	0.00	5.00
11	5.00	0.00	5.00	31	4.33	1.15	5.00
12	5.00	0.00	5.00	32	5.00	0.00	5.00
13	4.00	1.00	4.00	33	2.00	1.73	1.00
14	5.00	0.00	5.00	34	4.67	.58	4.00
15	3.00	1.00	3.00	35	4.00	0.00	4.00
16	3.33	.58	3.00	36	3.33	.58	3.00
17	4.33	.58	4.00	37	5.00	0.00	5.00
18	2.50	0.00	2.50	38	5.00	0.00	5.00
19	2.67	1.15	2.00	39	2.06	.58	3.00
20	4.33	.58	4.00	40	3.66	.58	4.00
Instruction	5.00	0.00	5.00				

We used this information to write the final versions of the items, instructions and response options for the Spanish version of the MDSI.

### 2.2. Results

Table 1 presents descriptive statistics for the experts’ ratings. Items 3, 6, 7, 9, 18, 33 and 39 received rating of 4 points or below and, consequently, these items were changed in various aspects suggested by the experts. They noticed words or expressions common in the Spanish spoken in Argentina but not in Spain. For example, we replaced “cuadras” with “calles” (streets), “manejar” with “conducir” (drive), “manejar más rápido” with “acelerar” (accelerate), “auto” with “coche” (vehicle), “esquinas” with “cruces” (junctions) and “carril rápido” with “carril izquierdo” (fast lane). Other items received rating of 5 points, and the experts did not provide comments. Lastly, following the experts’ suggestions, we also decided to rewrite the item stems and use the first person singular to encourage participants to respond to the items with their own driving experience in mind, for instance: “I drive somewhere other than the intended destination”, instead of “Driving somewhere else to other than the intended destination” in the Argentinian version.

### 2.3. Discussion and conclusions

The experts’ evaluations indicated expressions, words, etc. of some items that would have to be changed to improve their appropriateness to the Spanish spoken in Spain. Likewise, the experts provided evidence about the adequacy of the items’ content to the context, regulations and driving habits of Spanish drivers, but no substantial changes were suggested.

## 3. Study

The objective of this study was to evaluate the psychometric properties of the Spanish version of the MDSI. Analyses were performed with samples of Spanish drivers in Spain. First, we analysed the MDSI-Spain’s internal structure and the reliability of the DS measures. Secondly, we obtained validity evidence of the relations of the MDSI DS measures with other variables: demographics (age and gender), reported accident rate, alcohol consumption, personality attributes not previously analysed, such as risk estimation in driving and other aspects of life, driving anger and sensitivity to punishment and reward, and reoffending (drivers who were on a compulsory re-education course to

have their driving license restored).

### 3.1. Method

#### 3.1.1. Participants

A total of 1173 participants, recruited through two different procedures, responded to the questionnaires.

Sample 1 was composed of university students. In addition, staff of the University of Granada (UGR) and people attending courses (training courses or compulsory re-education courses to have their licenses restored) at the Victoria and Genil driving schools were also included in the sample. The questionnaires were administered collectively or individually in the presence of the researchers.

Sample 2 was recruited using a procedure that involved delivering envelopes with the questionnaires for the participants to complete on their own and return to the researchers by post. Envelopes with three questionnaires were distributed to students participating in the study, to be completed independently by them and their (driver) parents.

The inclusion criteria were a) having a driving license; and b) driving regularly. Participants were asked about driving experience and the responses grouped into three categories: less than two years driving regularly, between 2 and 5 years, and more than 5 years. Furthermore, both sample data bases were refined using the following criteria for MDSI responses: (a) having 3 or less missing values; and (b) not presenting “aberrant” response patterns (specifically, repeating the same response more than 10 consecutive times and responding to less than 4 different options in all the items). For the cases with 3 or fewer missing values, the “Predictive mean matching” imputation method was applied (Landerman et al., 1997).

Final sample size consisted of 1032 participants (435 for Sample 1 and 597 for Sample 2). Sample 1 participants' ages ranged from 18 to 81 years ( $M = 44.4$ ;  $SD = 16.7$ ), 61.5 % of whom were men and 38.5 % women. Eighty per cent of the drivers reported having driven regularly for more than 5 years, 9.2 % had driven regularly for between 2 and 5 years and 10.8 % for less than 2 years. Education levels in Sample 1 were: primary studies (20.6 %), secondary studies (31.6 %) and higher education (47.8 %).

Age range in Sample 2 was from 18 to 79 years ( $M = 39.6$ ;  $SD = 15.7$ ). Men comprised 47.4 % of the participants and women 52.6 %. Sixty-one per cent of drivers reported that they had driven regularly for more than 5 years, 17.4 % for between 2 and 5 years and 21.6 % for less than 2 years. Education levels in Sample 2 were: primary studies (19.5 %), secondary studies (43.2 %) and higher education (37.3 %).

Taking into account the whole sample, we found 88.2 % were Non-offender drivers ( $N = 904$ ) and 11.8 % Offender drivers ( $N = 121$ ). Offender drivers reported having had their licenses withdrawn and having been through a re-education process to have it restored. A demerit points system for driving licenses is applied by the Spanish Government (DGT): Spanish drivers are issued with 12 points initially, but points are deducted from the license according to severity when a driving offence is committed.

#### 3.1.2. Analysis

A measurement invariance analysis was performed to analyse whether the two samples from the two data collection procedures fitted to the factor structure of the Argentinian MDSI (Poó et al., 2013), since this was the source version for the MDSI Spain adaptation. If invariance was reached, the two samples could be merged. Subsequently, we proceeded to analyse the underlying factorial structure of the questionnaire with the merged sample. Initially, two random samples were generated from the total sample: the first random sample to explore the factor structure by means of an Exploratory Factor Analysis (EFA) and the second to test it by means of a Confirmatory Factor Analysis (CFA). Once the factorial structure had been confirmed, descriptive and reliability analyses were carried out for each driving style (DS).

We also examined the associations between the MDSI styles and

different sociodemographic variables. A *t*-test for gender, a Spearman correlation for level of education and a Pearson correlation for age were performed. Subsequently, we assessed the relations between the DS and variables associated with driving history, carried out a *t*-test for re-offending and a one-way ANOVA for number of years driving regularly (less than 2 years, between 2 and 5 years and more than 5 years). To analyse the associations between DS and personality traits, we calculated the Pearson correlation with the DBQ sub-scales (Lapses, Errors, Violations, Aggressive Violations), the DAS sub-scales (Anger at Traffic Obstructions, at Illegal Behaviour, at Hostile Gestures), the DOSPERT sub-scales for hazard perception (Social, Recreational, Financial, Health/Security, Ethics) and the SPSRQ sub-scales (Sensitivity to Punishment and Sensitivity to Reward). In addition, we performed a one-way ANOVA for a diagnosis based on the AUDIT (No alcohol consumption risk, Moderate-Hazardous alcohol consumption and Alcohol Dependence Syndrome, ADS). Lastly, we carried out a two-step cluster analysis to find driver profiles, using the DS as a starting point. This analysis would also be of use to explore the dimensionality of the MDSI.

#### 3.1.3. Instruments

Several questionnaires were included to obtain validity evidence of the relationships between driving styles and some theoretical related constructs (i.e. Taubman and Yehiel, 2012).

The Driver Behavior Questionnaire (DBQ; Reason et al., 1990) consists of 28 items intended to measure four dimensions: Lapses, Errors, Violations and Aggressive Violations. The questionnaire uses a Likert-type scale, with 5 frequency categories: never (0), almost never (1), occasionally (2), very frequently (3), almost always (4) and always (5). It has been adapted to the Spanish population by Gras et al. (2006) and shows adequate psychometric properties, with values for the Cronbach alpha coefficients ( $\alpha$ ) above .59 for all dimensions. The Errors factor explained 21.1 % of total variance, Violations 9.24 %, Aggressive Violations 5.75 % and Lapses 4.75 %. The Cronbach alpha coefficient in our data set was .90 for the questionnaire, .79 for Errors, .75 for Violations, .74 for Aggressive Violations and .70 for Lapses.

The Driving Anger Scale (DAS; Deffenbacher, Oetting & Lynch, 1994) was adapted to the Spanish population by Herrero-Fernández (2011). The DAS is a self-report instrument containing 14 Likert-type items with 5 response options ranging from 1 “not at all” to 5 “a lot”. The DAS measures three factors related to anger while driving: Traffic Obstructions, Illegal Behaviour and Hostile Gestures. It presents adequate internal consistency in both the Spanish adaptation ( $\alpha = .84$ ) and in our study (Total scale  $\alpha = .83$ , Anger at Traffic Obstructions  $\alpha = .74$ , Anger at Illegal Behaviour  $\alpha = .70$  and Anger at Hostile Gestures  $\alpha = .87$ ).

The Domain-Specific Risk-Taking Scale (DOSPERT) was developed by Blais and Weber (2006) to evaluate risk-taking in different domains: Social, Recreational, Financial, Health/Security and Ethics. The questionnaire was adapted to the Spanish population by Horcajo et al. (2014) and Lozano et al. (2017). The adaptation has 30 Likert-type items with 7 response categories, expressing the probability of each type of risky behaviour from 1 “extremely unlikely” to 7 “extremely likely”. For this study, we have used the Hazard Perception sub-scale. In our data set, Cronbach's alpha values are of .85 for the total scale, .66 for the Social domain, .78 for the Recreational domain, .60 for the Financial domain, .74 for the Health/Security domain and .65 for the Ethics domain.

The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ), created by Torrubia et al. (2001), evaluates the functioning of behaviour activation and inhibition systems via 48 items. Aluja and Blanch (2011) proposed a shorter and psychometrically improved structure of 20 items, using factorial, discriminant and convergent validation methods. The response format is Likert-type with 4 categories expressing the degree of agreement from 1 “disagree strongly” to 4 “agree strongly”. For this last version, the Cronbach's

alpha reliability coefficient vary between .77 and .80 for Sensitivity to Punishment and between .70 and .73 for Sensitivity to Reward. In our study the alpha values were .81 for both sub-scales.

The Alcohol Use Disorders Identification Test (AUDIT) was developed by Saunders et al. (1993) to identify persons at risk of developing alcohol problems. It is a questionnaire of 10 items that cover the domains of alcohol consumption, drinking behaviour and alcohol-related problems, and that establishes three possible diagnoses: No alcohol consumption risk, Moderate-Hazardous alcohol consumption, and Alcohol Dependence Syndrome (ADS). It was adapted to Spanish by Guillamón et al. (1999), presenting good internal consistency (a global = .88, in our sample .83)

In addition, an ad hoc questionnaire was designed with various questions regarding sociodemographic variables (i.e., age, gender, educational level), and driving history variables (i.e. reoffending, number of accidents and number of infractions (with a fine as the penalty).

### 3.2. Results

#### 3.2.1. Analysis of Invariance for the collection procedures

We performed an invariance analysis to make sure that the six-factor structure proposed by Poó et al. (2013) was maintained in the two samples from each procedure of data collection. The results of the structural invariance indicated a good fit to the Poó et al. (2013) factor structure: for Sample 1 [ $\chi^2(734.96) = 1973.38, p < .01; \chi^2/df = 2.68; RMSEA = .06; SRMR = .078$ ], and likewise for Sample 2 [ $\chi^2(2.23) = 1617.63, p < .01; RMSEA = .06; SRMR = .08$ ]

For the remaining invariance models, the value for  $\Delta\chi^2$  is significant, probably due simply to the large size of the samples. Taking this into account and bearing in mind that, according to Cheung and Rensvold (2002), a value of  $\Delta CFI$  equal to or less than .01 indicates that the hypothesis of null variance should not be dismissed, we assumed the structural invariance level [ $\Delta\chi^2(p\text{-value}) = 106.44 (< .001); \Delta CFI = .007; \Delta RMSEA = .003$ ]. These results allowed us to merge the two samples, disregarding the presence of any “recruitment” method bias.

#### 3.2.2. Exploratory factorial analysis

First, a parallel analysis (Horn, 1965) was carried out, which suggested a 6-factor structure. On performing the EFA (Estimation method: ULS, Rotation: Oblimin), we found that the 6 factors explained 33 % of the total variance and showed good value of fit indices [ $\chi^2(555) = 1077.25, p < .01; \chi^2/df = 1.94; RMSEA = .04; SRMR = .03$ ].

As Table 2 shows, EFA results indicate that items 5, 7, 18, 22, 30, and 31, have lower communalities than expected, high factor loadings in several factors and no clear theoretical relation with other items in the same factor.

The EFA was repeated, removing these items. The 6 factors then explained 38 % of the total variance and the fit indices were: [ $\chi^2(372) = 716.74, p < .01; \chi^2/df = 1.93; RMSEA = .04; SRMR = .03$ ]. The 6-factor structure obtained exactly replicated that of Poó et al. (2013) and the factors were labelled in the same way. The first factor consists of 7 items and explains 8.5 % of the total variance, reflecting the Reckless DS (in the Argentinian version of the MDSI this factor consists of 9 items and explains 19.9 % of the variance). The second factor consists of 4 items and explains 6.1 % of the total variance, reflecting the Anxious DS (in the Argentinian version of the MDSI this factor consists of 4 items and explains 4.05 % of the variance). The third factor consists of 7 items and explains 5.9 % of the total variance, reflecting the Careful DS (in the Argentinian version of the MDSI this factor consists of 6 items and explains 4.6 % of the variance). The fourth factor consists of 4 items and explains 5.4 % of the total variance, reflecting the Angry DS (in the Argentinian version of the MDSI this factor consists of 6 items and explains 4.8 % of the variance). The fifth factor

**Table 2**  
Factorial weights of the eliminated items.

Item	Wording	Reckless	Anxious	Careful	Angry	Dissociative	Distress Reduction
5	Paso un semáforo que justo acaba de ponerse en rojo. (25# "I drive through traffic lights that have just turned red") <sup>a</sup>	.05	-.03	-.20	.29	.23 (.31*)	.16
7	Conduzco por encima del límite de velocidad en la ciudad.(7# "I drive over the speed limit in the city")	.14 (.39*)	-.03	-.15	.19	.11	.17
18	Accelero cuando un vehículo intenta adelantarme. (9# "I drive faster when a vehicle is trying to overtake me")	.28(.30*)	-.02	-.14 (-.31*)	.28	.18	-.06
22	Pienso en otras cosas para distraerme mientras conduzco. (37# "I daydream to pass the time while driving") <sup>a</sup>	-.14	-.04	-.11	.17	.44	.11 (.46*)
30	Doy a las luces en lugar de activar el limpiaparabrisas. (14# "I switch on the lights instead of the windshield wipers") <sup>a</sup>	-.01	.37	.08	-.02	.24 (.47*)	.08
31	Salgo del semáforo en tercera y se me cala (11# "I drive away from traffic lights in third gear") <sup>a</sup>	.18	.35	.01	-.09	.23 (.66*)	.03

\* Weight of items in the Argentinian version of the MDSI (Poó et al., 2013, page 80).  
<sup>a</sup> Items that belong to the original version of the MDSI (Traubman – Ben-Ari et al., 2004).

**Table 3**  
CFA standardised weights AFC, Gronbach's alpha and descriptive statistics.

Styles	Items	Standardised weight	$\alpha$	Mean	SD	$r_{ix}$
	Only confirmation sample (N = 515)			Total sample (N = 1032)		
Reckless	2	Me pego a otros vehículos a propósito(8# "I purposely tailgate other drivers") <sup>a</sup>	.52	1.5	.89	.45
	4	Disfruto de la potencia del motor (2#, "I enjoy the power of the engine")	.66	2.7	1.6	.62
	6	Disfruto de la sensación de conducir al límite(1# "I enjoy the sensation of driving at the limit") <sup>a</sup>	.80	1.7	1.2	.70
	9	Disfruto al cambiar de marcha con rapidez (3# "I enjoy shifting gears quickly")	.60	2.5	1.5	.57
	15	Siento que el vehículo pide más velocidad (4# "I feel the car is asking for more speed")	.47	2.6	1.4	.47
	26	Me gusta asumir riesgos mientras conduzco (6# "I like to take risks while driving") <sup>a</sup>	.61	1.4	.85	.51
Anxious	40	Disfruto de la conducción peligrosa(5# "I enjoy the excitement of dangerous driving") <sup>a</sup>	.77	1.4	.94	.64
	10	Me frustra conducir (35# "Driving makes me feel frustrated") <sup>a</sup>	.59	1.9	1.3	.50
	23	Me siento estresado mientras conduzco (32# "I feel stressed while driving") <sup>a</sup>	.85	2.0	1.2	.64
	28	Me siento nervioso mientras conduzco (33# "I feel nervous while driving") <sup>a</sup>	.80	1.8	1.1	.63
Careful	29	Me impaciento en las horas punta(34# "I get impatient during the rush hours") <sup>a</sup>	.25	2.9	1.4	.24
	13	Cuando se pone en verde el semáforo espero un momento a que arranquen los vehículos que me preceden (24# "When a traffic light turns green and the car in front of me does not get going, I just wait for a while until it moves") <sup>a</sup>	.35	3.79	1.7	.29
	17	Espero pacientemente a que el tráfico pase en una intersección donde tengo que ceder el paso (31# "I wait patiently for the traffic to pass at an intersection where I don't have right of way") <sup>a</sup>	.47	4.41	1.5	.48
Angry	21	Conduzco siguiendo el dicho "más vale prevenir que curar" (28# "I base my behaviour on the motto 'better safe than sorry'") <sup>a</sup>	.61	4.54	1.4	.46
	33	Espero pacientemente cuando no tengo prioridad (29# "I wait patiently when I don't have right of way")	.58	4.42	1.5	.49
	34	Planeo los viajes largos con antelación (30# "I plan long journeys in advance") <sup>a</sup>	.50	4.63	1.3	.40
	37	Estoy preparado para reaccionar ante las maniobras inesperadas de otros conductores (27# "I am ready to react to unexpected manoeuvres by other drivers") <sup>a</sup>	.40	4.58	1.1	.32
	38	Suelo conducir con precaución (26# "I tend to drive carefully") <sup>a</sup>	.65	5.06	1.0	.44
	3	Toco a menudo la bocina o hago luces en señal de enfado (23# "I often sound my horn or 'flash' the car in front") <sup>a</sup>	.62	1.82	1.1	.48
Dissociative	12	Insulto a otros conductores (20# "I swear at other drivers") <sup>a</sup>	.71	1.77	1.1	.50
	25	Discuto con otros conductores o peatones (21# "I argue with other drivers or pedestrians")	.64	1.54	.9	.50
	39	Me enfado con personas que conducen lento en el carril rápido (22# "I get angry with people who drive slowly in the fast lane")	.54	2.90	1.4	.29
	11	Doy vueltas de más para llegar a un destino (16# "I take a roundabout route to reach my destination")	.43	1.92	1.2	.36
	14	Dissociative no me doy cuenta de que un peatón está cruzando (18# "Lost in thoughts or distracted, I fail to notice someone on the pedestrian crossing") <sup>a</sup>	.55	1.99	1.0	.47
	16	Me salto un semáforo en rojo dejándome llevar por el tráfico (19# "I jump a red traffic light following the other traffic")	.39	1.56	.9	.26
Distress Reduction	20	Freno bruscamente para evitar un choque por ir Dissociative (17# "I am often distracted or preoccupied, and suddenly have to slam on the brakes to avoid a collision") <sup>a</sup>	.42	2.47	1.3	.36
	28	Olvído que llevo puestas las luces largas (12# "I forget that my lights are on full beam") <sup>a</sup>	.47	1.80	1.0	.38
	27	Conduzco hacia un sitio distinto del que tenía intención de conducir (10# "I drive somewhere other than the intended destination")	.43	1.59	.9	.33
	32	Planeo mal la ruta y encuentro tráfico que podría haber evitado (13# "I plan my route badly, so that I hit traffic that I could have avoided") <sup>a</sup>	.36	2.12	1.1	.40
	35	Casi chocó por no calcular bien las distancias en un aparcamiento (15# "I nearly hit something due to misjudging the gap in a parking place") <sup>a</sup>	.60	2.16	1.2	.44
	1	Escucho música y me relajo mientras conduzco (36# "I listen to music to relax while driving") <sup>a</sup>	.56	3.96	1.4	.48
Distress Reduction	8	Intento relajarme mientras conduzco (40# "I try to relax while driving") <sup>a</sup>	.60	3.67	1.5	.46
	19	Disfruto del paisaje mientras conduzco (39# "I enjoy the landscape while driving")	.61	3.10	1.5	.42
	36	Mientras conduzco voy pensando y reflexionando (38# "I meditate while driving") <sup>a</sup>	.50	3.00	1.3	.35

All the items were adapted from the Argentinian version of the MDSI (Poó et al., 2013).

# Number corresponding with the Argentinian version of the MDSI.

<sup>a</sup> Items that belong to the original version of the MDSI (Traubman – Ben-Ari et al., 2004). A total of 23.

**Table 4**  
Correlations between Driving Styles (DS) of the MDSI.

	Reckless	Anxious	Careful	Angry	Dissociative	Distress Reduction
<b>Reckless</b>						
<b>Anxious</b>	-.02					
<b>Careful</b>	-.41**	-.06				
<b>Angry</b>	.62**	.07	-.29**			
<b>Dissociative</b>	.42**	.54**	-.20**	.46**		
<b>Distress Reduction</b>	.39**	-.04	.14**	.28**	.33**	

\*p < 0,01.

consists of 8 items and explains 5.8 % of the total variance, reflecting the Dissociative DS (in the Argentinian version of the MDSI this factor consists of 10 items and explains 10.6 % of the variance). Lastly, the sixth factor consists of 4 items and explains 3.9 % of the total variance, reflecting the Distress Reduction DS (in the Argentinian version of the MDSI this factor consists of 4 items and explains 3.4 % of the variance).

**3.2.3. Confirmatory factorial analysis**

Once the structure was known by means of the EFA, we proceeded to confirm it by carrying out a CFA on the second random sample (Estimation: Robust ML). The indices used show that the model has a satisfactory goodness of fit  $\chi^2(512) = 1263.29, p < .01; \chi^2/df = 2.47; RMSEA = .05; SRMR = .08; GFI = .97; AGFI = .96; CFI = .80; TLI = .78$ . All the items from the original MDSI from Israel, which were included in the Argentinian version, have been maintained, demonstrating a systematic consistency in the three MDSI versions (Israel, Argentina, Spain). The item factor loadings and the correlations between factors are shown in Tables 3 and 4, respectively. In Table 4, the correlations between the different styles are shown. The pattern of correlations found is practically identical to the one obtained in the Argentinian version of the MDSI. The only small difference is a few low correlations found in the Argentinian version between Anxious DS and each of the styles. However, in the Spanish version, the high correlation between Anxious DS and Dissociative DS is maintained. The final version of the MDSI-Spain can be found in Appendix A.

**3.2.4. Two-step cluster analysis**

The results of the two-step cluster analysis using the different DS generated a two-cluster structure. The quality of the clusters, according to Kaufman and Rousseeuw’s (1990) criteria, is sufficient (the silhouette coefficient is .3). The cluster averages for each of the DS are shown in Table 5. The DS with the highest score in importance (that is, the most important in the formation of the cluster) is Dissociative, and the one with the lowest score in importance is Careful.

The grouping of the clusters generated two driver profiles. One of these has the highest average in adaptive DS (Careful DS) while the other has a higher average in the DS we would consider maladaptive (Dissociative, Angry, Reckless, Anxious and Distress Reduction). The first driver profile could be labelled “adaptive drivers” (forming 59.2 % of the sample, N = 611), and the second one “maladaptive” (forming 40.8 %, N = 421).

**Table 5**  
Average DS in each of the clusters.

	Importance	Adaptive	Maladaptive
<b>Dissociative</b>	1.00	1.66	2.38
<b>Angry</b>	.95	1.70	2.68
<b>Reckless</b>	.89	1.60	2.54
<b>Anxious</b>	.60	1.80	2.69
<b>Distress Reduction</b>	.25	3.18	3.81
<b>Careful</b>	.06	4.59	4.34

The results of the cluster analysis provide clear validity evidence for the dimensionality of the Spanish MDSI in Spain, since they allow us to group them into two main features representing two types of driver (adaptive and maladaptive driving styles).

**3.2.5. Relationship between DS and sociodemographic variables**

The results of the independent-samples t-test for gender differences for the different DS are shown in Table 6. The greatest effect sizes were found for the Reckless and the Careful DS, these being, in rough terms, medium and large. In Reckless and in Angry DS, men obtained higher scores than women, whereas in Careful and in Anxious DS, women scored higher than men. The differences point in the same direction as those of Argentina for Reckless, Angry, Careful and Anxious DS. However, in the MDSI-Spain, no significant differences were found for Dissociative or Distress Reduction, while these were found in the Argentinian version.

For Age, negative correlations were found with the following styles: Risky,  $r(1028) = -.24, p < .001$ ; Anxious,  $r(1028) = -.07, p = .017$ ; Angry,  $r(1028) = -.20, p < .001$ ; Dissociative,  $r(1028) = -.11, p < .001$ ; and Distress Reduction,  $r(1028) = -.24, p < .001$ . In the Argentinian version, a significant relationship was also found with Careful DS, which in our study was null.

In addition, Age was grouped in three categories: in the first, participants between 18 and 25 years were grouped together (young), in the second, those between 25 and 70 (middle-aged), and in the third group, those over 70 (elderly). Subsequently, one-way ANOVAs were performed to compare the average DS in these three categories (Fig. 1). The results were significant for Reckless DS,  $F(21,025) = 27, p < .001$ , partial  $\eta^2 = .05$ ; Anxious  $F(2,1025) = 5.25, p < .01$ , partial  $\eta^2 = .010$ ; Careful,  $F(21,025) = 3.70, p < .05$  partial  $\eta^2 = .02$ ; Aggressive  $F(21,025) = 14.76, p < .001$ , partial  $\eta^2 = .028$ ; Dissociative  $F(2,1029) = 16.05, p < .001$ , partial  $\eta^2 = .030$ ; and Distress Reduction  $F(2,1025) = 26.55, p < .001$ , partial  $\eta^2 = .049$ .

Multiple comparisons using the post-hoc Tukey test were performed to explore differences between age groups. For Reckless DS, the young group had higher scores than the middle-aged group (Means Difference, MD = .40, Standard Error, SE = .05,  $p < .01$ ). For Anxious DS, the young group had higher scores than the middle-aged group (MD = .20, SE = .06,  $p = .004$ ). For Careful DS, the young group had higher scores than the elderly group (MD = .43, SE = .17,  $p = .028$ ) and the middle-aged group also had higher scores than the elderly group (MD = .45, SE = .17,  $p = .018$ ). For Aggressive DS, the young group had higher scores than the middle-aged group (MD = .30, SE = .06,  $p < .001$ ). For Dissociative DS, the young group had higher scores than the middle-aged group (MD = .22, SE = .04,  $p < .001$ ). Finally, for Distress Reduction DS, the young group had higher scores than the middle-aged group (MD = .44, SE = .07,  $p < .001$ ) and the elderly group (MD = .91, SE = .21,  $p < .001$ ).

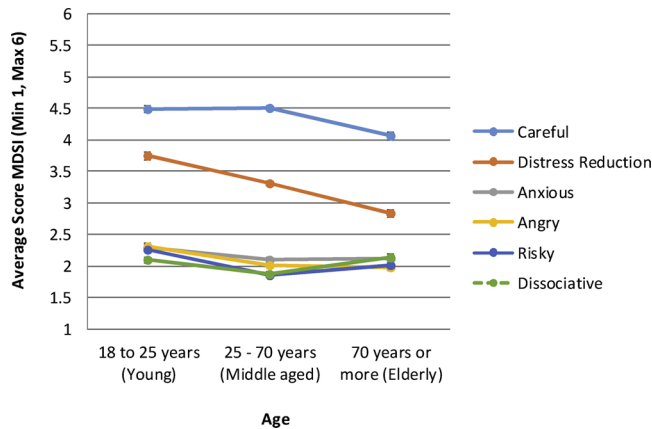
Lastly, a one-way ANOVA was performed to compare educational level for the different MDSI styles (Fig. 2). Significant differences were found for Careful DS,  $F(2, 1025) = 7.80, p < .001$ , partial  $\eta^2 = .015$ , and for Distress Reduction DS,  $F(2, 1025) = 11.87, p < .001$ , partial  $\eta^2 = .023$ . However, the value of the partial  $\eta^2$  indicates that educational level only explains 1.5 % of the variance of Careful DS, and 2.3 % of the variance of Distress Reduction DS.

Multiple comparisons using the post-hoc Tukey test were calculated to explore differences between educational level groups. For Careful DS, the low educational level group had lower scores than the medium educational level group (MD = -.27, SE = .07,  $p < .001$ ), and the high educational level group (MD = -.16, SE = .07,  $p = .047$ ). For Distress Reduction DS, the low educational level group had lower scores than the medium educational level group (MD = -.40, SE = .08,  $p < .001$ ), and the high educational level group (MD = -.34, SE = .08,  $p < .001$ ).

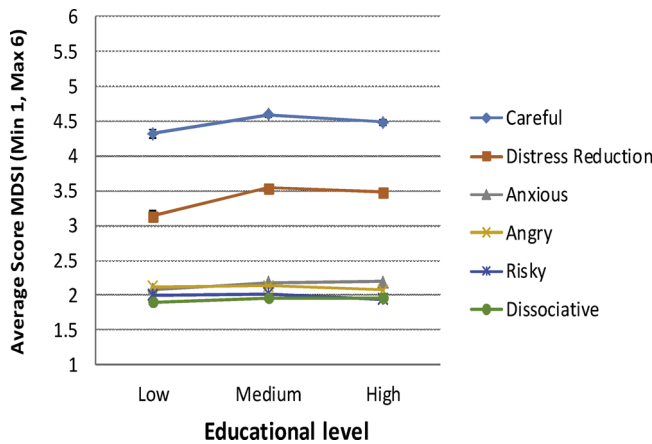
**Table 6**  
Independent-samples *t*-test for gender.

Gender		Reckless	Anxious	Careful	Angry	Dissociative	Distress Reduction
M (N = 550) 53.3 %	Mean	2.17	2.05	4.39	2.26	1.93	3.45
	SD	.91	.81	.82	.87	.59	.99
F(N = 481) 46.7 %	Mean	1.78	2.29	4.61	1.92	1.98	3.42
	SD	.68	1.01	.77	.75	.61	.99
T (gl)		8.02 (1003)***	-4.18 (915)***	-4.45 (1025)***	6.71 (1028)***	-1.38 (1029)	.59 (1029)
Cohen's d		.41	.25	.73	.35	.10	.26

\*\*\* *p* < .0001.



**Fig. 1.** Age and MDSI Driving Styles (Careful, Distress Reduction, Anxious, Angry, Risk and Dissociation, respectively (top, bottom)).



**Fig. 2.** Educational level and MDSI Driving Styles (Careful, Distress Reduction, Anxious, Angry, Risk and Dissociation, respectively (top, bottom)).

**3.2.6. Relationship between DS and driving history variables**

The results of the independent-samples *t*-test for reoffending are shown in Table 7. The reoffenders have higher scores on the Reckless and Aggressive DS than non-offenders, and the non-offenders have

**Table 7**  
Independent-samples *t*-test for offender-status.

Offender-status		Reckless	Anxious	Careful	Angry	Dissociative	Distress Reduction
Offender (N = 121); 11.80% Non-Offender (N = 904); 82.20%	Mean	2.32	2.04	3.95	2.36	1.90	3.22
	SD	1.03	.82	.91	.85	.56	.96
t(gl) Cohen's d	Mean	1.94	2.18	4.56	2.07	1.96	3.47
	SD	.80	.93	.76	.83	.61	1.00
		3.93 (140)***	-1.65 (1023)	-6.97 (143)***	3.60 (1023)***	-1.02 (1023)	-2.61 (1023)***
		.49	.26	.28	.42	.08	.03

\*\*\* *p* < .001.

higher scores on the Careful and Distress Reduction DS than offenders, while no differences were found in the Anxious and Dissociative DS. The most notable effect sizes are those of Reckless and Angry DS, these being of medium size. This indicates a greater tendency for reoffenders to take risks and to be easily roused to anger, which could be associated with the higher rate of incidents and violations committed by them on the roads.

The one-way ANOVA for number of years driving and DS yielded a significant result for Reckless DS  $F(21,029) = 18.80, p < .001$ , partial  $\eta^2 = .03$ ; Anxious DS  $F(21,029) = 8.84, p < .001$ , partial  $\eta^2 = .02$ ; Aggressive  $F(2,1029) = 8.08, p < .001$ ; partial  $\eta^2 = .02$ , Dissociative DS  $F(2,1029) = 13.15, p < .001$ , partial  $\eta^2 = .02$ ; and Distress Reduction DS  $F(2,1029) = 15.72, p < .001$ , partial  $\eta^2 = .03$  (See Fig. 3).

Multiple comparisons using the post-hoc Tukey test were performed to explore differences in driving experience. For Reckless DS, less than 2 years driving had lower scores than between 2 and 5 years driving ( $MD = -.31, SE = .09, p = .002$ ), and between 2 and 5 years driving had higher scores than more than 5 years driving ( $MD = .45, SE = .07, p < .001$ ). For Anxious DS, less than 2 years driving had higher scores than more than 5 years driving ( $MD = .31, SE = .08, p < .001$ ). For Aggressive DS, less than 2 years driving had lower scores than between 2 and 5 years driving ( $MD = -.25, SE = .09, p = .018$ ), and between 2 and 5 years driving had higher scores than more than 5 years driving ( $MD = .36, SE = .08, p < .001$ ). For Dissociative DS, less than 2 years driving had higher scores than more than 5 years driving ( $MD = .24, SE = .05, p < .001$ ) and between 2 and 5 years driving had higher scores than more than 5 years driving ( $MD = .15, SE = .05, p = .016$ ). Finally, for Distress Reduction DS, less than 2 years driving had higher scores than more than 5 years driving ( $MD = .23, SE = .08, p = .018$ ) and between 2 and 5 years driving scored higher than more than 5 years driving ( $MD = .48, SE = .09, p < .001$ ).

The most significant and largest Pearson correlations of DS with the data of fines and reported accident rate are the following: Reckless DS is related to the number of fines since acquiring a license,  $r(922) = .15, p < .001$ , Anxious DS is related to the number of fines,  $r(922) = -.12, p < .001$ , and Angry DS is related to the number of accidents with material damage since acquiring a license,  $r(943) = .11, p = .001$ , and to the number of fines,  $r(922) = .12, p < .001$ .

**3.2.7. Relationship between DS and other driving-related constructs**

Results of the analysis of the relations between DS and the different

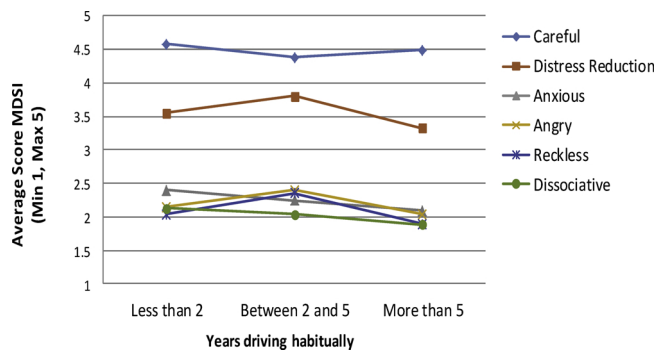


Fig. 3. Driving experience and MDSI Driving Styles. (Careful, Distress Reduction, Anxious, Angry, Risky and Dissociative, respectively (top, bottom).

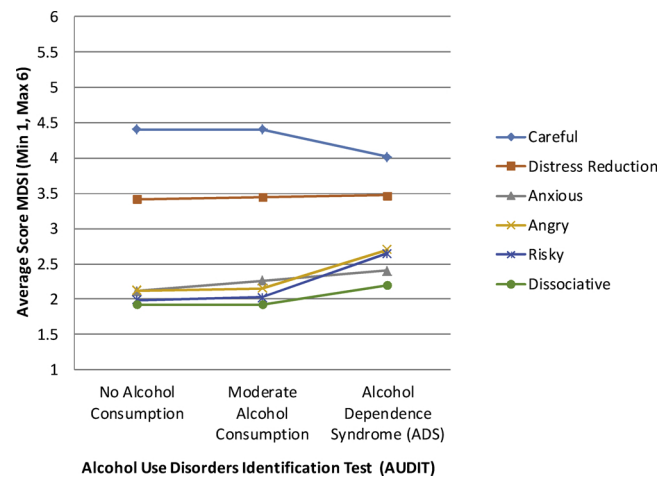


Fig. 4. AUDIT diagnosis and MDSI Driving Styles.

constructs considered in the study are shown in Table 8. Firstly, the correlations of the DS scores with the DBQ sub-scales indicate various interesting results. The Reckless and Angry DS correlate positively and strongly with the sub-scales Violations and Aggressive Violations. In a sense, these styles would be evaluating a construct very similar to those of the DBQ scales. In some way, they are all related to imprudence and aggression on the road. The Dissociative DS correlates substantively and positively with the sub-scales Lapses and Errors, an expected result, given that in all these measures there is an underlying attentional construct. Lastly, another noteworthy result is the negative correlations of the Careful DS with the four DBQ sub-scales, that is, a Careful driver tends to respond to the DBQ showing a safe style of driving.

We should also pay attention to the correlations of the DS with the sub-scales of the DAS. The most intense and positive correlations are shown between the Angry DS and the three sub-scales of the DAS. With regard to the DOSPERT, the highest and most systematic correlations are shown between the Reckless DS and the scales of risk perception, Financial, Health/Security and Ethics of the DOSPERT. These correlations are negative, meaning that a lower hazard perception in these spheres corresponds to a higher Reckless DS.

Regarding the SPQRS, we found that the Reckless DS correlates intensely and positively with the Sensitivity to Reward scale, indicating that those who take risks on the road are more sensitive to rewards and therefore seek intense sensations when driving. The Anxious DS correlates positively with the Sensitivity to Punishment scale. This could be interpreted as a greater sensitivity to the possible dangers of the road, which is expressed as a greater state of anxiety when driving.

The one-way ANOVA for diagnostics carried out from the AUDIT: no alcohol consumption risk, hazardous alcohol consumption and harmful alcohol consumption (ADS; Alcohol Dependence Syndrome) and DS

(Fig. 4) indicated a significant result for Reckless DS,  $F(2384) = 9.62$ ,  $p < .001$ , partial  $\eta^2 = .05$ ; Careful DS,  $F(2384) = 1.90$ ,  $p = .033$ , partial  $\eta^2 = .02$ ; Angry DS,  $F(2384) = 8.05$ ,  $p < .001$ , partial  $\eta^2 = .040$ ; and Dissociative DS,  $F(2384) = 3.74$ ,  $p = .025$ , partial  $\eta^2 = .02$ . Once again, the effect sizes are quite low, ranging from 1.8 % to 4.8 % of the explained variance.

#### 4. Discussion

The aim of the study was to adapt and provide validity evidence for the MDSI for Spanish drivers in Spain. The adaptation was carried out taking into account not just the Spanish spoken in Spain, but also the culture, norms, and traffic habits. The Spanish version of the MDSI consists of 34 items and shows adequate psychometric properties. The factor structure is the same as that of the Argentinian version of the MDSI, including 23 items from the original MDSI, which are also in the Argentinian version, indicating the construct overlap across the three versions of the MDSI. Our analyses reaffirm that the MDSI can serve as a diagnostic instrument for sketching the profiles of safe vs unsafe drivers, based on the different adaptive and maladaptive DS of which it is comprised. It can be used for evaluation as well as for planning interventions directed at mitigating the deficits detected and could reveal behavioural problems both on the road and in other spheres of drivers' lives.

All things considered, a satisfactory adaptation of the MDSI has been carried out, allowing us to confirm the universality of the MDSI's

Table 8  
Correlations between MDSI styles and different psychological constructs.

		Driving Styles					
		Reckless	Anxious	Careful	Angry	Dissociative	Distress Reduction
DBQ: Driver Behaviour Questionnaire	Lapses (N = 581)	.19***	.36***	-.17***	.20***	.51***	.15***
	Errors (N = 589)	.32***	.30***	-.31***	.29***	.48***	.12**
	Violations (N = 581)	.58***	.16***	-.33***	.51***	.34***	.27***
	Aggressive violations (N = 590)	.43***	.13***	-.21***	.67***	.19***	.19***
DAS: Driving Anger Scale (N = 429)	Anger at Traffic Obstructions	.28***	.24***	-.16**	.36***	.25***	.11*
	Anger at Illegal Behaviour	.10*	.11*	.09	.25***	.03	.05
	Anger at Hostile Gestures	.08	.27***	-.02	.25***	.22***	.07
DOSPERT: Risk Perception Scale (N = 426)	Social	.09	.05	-.14**	.09	.10*	-.003
	Recreational	-.30	.16	.12	-.16	.01	-.13
	Financial	-.20***	.03	.01*	-.05	-.08	-.03
	Health/Security	-.25***	-.01	.18***	-.22***	-.13**	-.09
	Ethics	-.27***	-.05	.20***	-.21***	-.13**	-.13**
SPQRS: (N = 427)	Sensitivity to Reward	.43***	.03	-.08	.28***	.18***	.13**
	Sensitivity to Punishment	.01	.20***	.10*	.05	.24***	.03

\* $p < .05$  \*\* $p < .01$  \*\*\* $p < .001$ .



DS and contribute new information regarding its associations with other variables related to driving in order to gain better knowledge of how DS function and to improve their predictive validity. With our analyses of the associations between the DS of the MDSI and a) demographic variables, b) driving history variables, and c) additional driving-related constructs, the study provides evidence of the predictive and convergent validity of the Spanish MDSI in Spain.

Firstly, men scored higher than women in some of the most maladaptive DS, reaching higher scores in Risky and Aggressive DS. Thus, the findings by Sagberg et al. (2015) and Shinar and Compton (2004) were replicated, in the sense that men show riskier driving behaviour. These authors also found a pattern of risky driving in young men, in particular. Women, on the other hand, showed higher scores in Careful DS, although they also scored higher in Anxious DS. Thus, the findings of previous versions of this questionnaire (e.g., Holland et al., 2010; Poó et al., 2013; Taubman – Ben-Ari, 2006, 2014; Taubman – Ben-Ari and Yehiel, 2012) were replicated. Middle-aged drivers attested to a lesser extent than young drivers to engaging in behaviour aimed at reducing stress while driving and demonstrated less distraction. They also showed a negative correlation with Risky and Aggressive DS. Thus, the results obtained by previous studies (Gwyther and Holland, 2012; Poó et al., 2013; Taubman – Ben-Ari, 2014; Taubman – Ben-Ari and Yehiel, 2012) were replicated with respect to the negative correlation between age and Risky and Aggressive DS. These findings also replicate the finding that young drivers admit to a greater extent to being angry and showing hostility when driving (Farah et al., 2007) and to being anxious (Taubman – Ben-Ari et al., 2004; Taubman – Ben-Ari and Katz – Ben-Ami, 2012; Taubman – Ben-Ari, 2014). It was found that experience (like age) correlates negatively with all the DS except Careful. Drivers with more experience take fewer risks, are less aggressive, less distracted, less anxious and engage less in tasks that reduce stress. Drivers who attested to deliberately behaving in ways directed at relaxing them when driving tended to be those with a higher educational level (but we found only one significant positive correlation between educational level and the Distress Reduction DS). There was also a marginal tendency to negative correlation with Risky and Aggressive DS as educational level increased. Taubman – Ben-Ari and Skvirsky (2016) affirm that a weak relationship between Anxious DS and educational level has been found only in some studies (Taubman – Ben-Ari et al., 2004) while others failed to find a relation with the MDSI factors (Poó et al., 2013; Taubman – Ben-Ari and Yehiel, 2012).

Secondly, reoffender drivers score higher in Risky and Aggressive DS, while non-offender drivers show higher scores in Careful and Distress Reduction DS. A positive correlation was also found between the number of offences reported by participants and Aggressive DS. A significant positive correlation of Risky and Anxious DS with the number of fines received was found. Angry DS was related to the number of accidents with material damage. This information is useful to ascertain which drivers are at risk, with regard to prevention and intervention (see Antoniazzi and Kein, 2019; Padilla et al., 2018).

Finally, significant positive associations were found between all the DS except Careful and all the sub-scales of the DBQ (Lapses, Errors, Violations and Aggressive Violations), and a significant negative correlation was found between Careful DS and all the sub-scales of the DBQ. Using the MDSI, it is possible to analyse driving profiles, not only by taking into account the maladaptive behaviour of the driver, but also by being sensitive to what might help to guarantee safe driving (Taubman – Ben-Ari and Skvirsky, 2016). The maladaptive DS of the MDSI correlate negatively with risk estimation in the sphere of Health/Security (Measured with the DOSPERS), which contains at least one item related to driving (use of a seatbelt). The other side of the coin is seen in a positive correlation between Careful DS and higher risk

estimation in the DOSPERS (Recreational; Finances, Health/Security, Ethics). In addition, Angry, Reckless, Dissociative and (to a lesser extent) Anxious DS correlated positively with the sub-facets of the DAS that measured Anger at Traffic Obstructions and at Illegal Behaviour. Similarly, a negative correlation was found between Careful DS and the sub-facet of the DAS that measured Anger at Traffic Obstructions. Moreover, a strong positive correlation was found between Risky and Aggressive DS and greater Sensitivity to Reward. A moderate positive correlation with Distracted and Distress Reduction DS was also found. The effectiveness of administering rewards, alternative incentives and discounts for the modification of the behaviour of risky and aggressive drivers should be assessed. With regard to Sensitivity to Punishment, it is Anxious and Distracted DS that show a moderate positive correlation. It is noteworthy that the correlation between Risky and Aggressive DS and Sensitivity to Punishment was not found to be significant. And lastly, from the diagnostic that can be performed with the AUDIT questionnaire regarding consumption of alcohol, drivers diagnosed with ADS (Alcohol Dependence Syndrome) show higher scores in Aggressive, Risky, Anxious and Distracted DS. Moreover, the participants with ADS show the lowest scores in Careful DS.

In conclusion, this work provides predictive and convergent validity evidence relating driving styles to sociodemographic, driving history and other driving-related traits. Beyond the provision of clear validity evidence, the findings are also innovative in that they present novel associations between the MDSI and a set of driving-related traits, such as aberrant driving behaviour, driving anger, risk perception, and sensitivity to punishment and reward. The results show systematic associations between the DS and the different driving-related traits considered, consistent with the theoretical framework of both. The MDSI is a unique questionnaire that not only relates to maladaptive and risky driving styles, but also provides an adaptive driving measure: the Careful Driving Style, which might be less subject to social desirability bias than the traditional driving measures, which are more closely related to maladaptive driving styles. In addition, the MDSI could be useful to analyse novice and offender drivers driving styles in further research.

#### CRediT authorship contribution statement

**Jose-Luis Padilla:** Conceptualization, Methodology, Writing - original draft, Supervision. **Candida Castro:** Conceptualization, Investigation, Writing - original draft, Supervision. **Pablo Doncel:** Formal analysis, Writing - original draft. **Orit Taubman - Ben-Ari:** Conceptualization, Writing - review & editing, Supervision.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Acknowledgments

We would like to thank the Spanish drivers who volunteered for the tests, the three experts who were asked to evaluate the items, instructions and response scale of the MDSI-Spain, and our English editor Barbara Lamplugh. The Spanish Government: DGT, *Dirección General de Tráfico, Ministerio del Interior* (SPI2015-01782) and MICINN, *Ministerio de Ciencia, Innovación y Universidades* (PSI2016-75086) gave us financial support. The study design, data collection, analysis and interpretation were carried out independently of the funding bodies, as were the writing up of the experiment and the decision to seek publication.

**Appendix A. Questionnaire MDSI-Spain. Part I**

Below is a series of phrases about how people drive. Please read each one carefully and indicate, using the 6-point Scale, to what extent you consider each of the phrases applies to you. Mark your response with a cross (X) on THE NUMBER in the box that represents your agreement with the following scale.

1-Nada Not at all, 2-Muy poco Very little, 3-Poco A little, 4-Regular Neutral, 5-Mucho Quite a lot, 6-Muchísimo A lot		
1	Escucho música y me relajo mientras conduzco (36# "I listen to music to relax while driving")	1 2 3 4 5 6
2	Me pego a otros vehículos a propósito (8# "I purposely tailgate other drivers") <sup>a</sup>	1 2 3 4 5 6
3	Toco a menudo la bocina o hago luces en señal de enfado (23# "I often sound my horn or "flash" the car in front") <sup>a</sup>	1 2 3 4 5 6
4	Disfruto de la potencia del motor (2#, "I enjoy the power of the engine")	1 2 3 4 5 6
5	Disfruto de la sensación de conducir al límite (1# "I enjoy the sensation of driving at the limit") <sup>a</sup>	1 2 3 4 5 6
6	Intento relajarme mientras conduzco (40# "I try to relax while driving") <sup>a</sup>	1 2 3 4 5 6
7	Disfruto al cambiar de marcha con rapidez (3# "I enjoy shifting gears quickly")	1 2 3 4 5 6
8	Me frustra conducir (35# "Driving makes me feel frustrated") <sup>a</sup>	1 2 3 4 5 6
9	Doy vueltas de más para llegar a un destino (16# "I take a roundabout route to reach my destination")	1 2 3 4 5 6
10	Insulto a otros conductores (20# "I swear at other drivers") <sup>a</sup>	1 2 3 4 5 6
11	Cuando se pone en verde el semáforo espero un momento a que arranque los vehículos que me preceden. (24# "When a traffic light turns green and the car in front of me does not get going, I just wait for a while until it moves") <sup>a</sup>	1 2 3 4 5 6
12	Distraído no me doy cuenta de que un peatón está cruzando (18# "Lost in thoughts or distracted, I fail to notice someone on a pedestrian crossing") <sup>a</sup>	1 2 3 4 5 6
13	Siento que el vehículo pide más velocidad (4# "I feel the car is asking for more speed")	1 2 3 4 5 6
14	Me salto un semáforo en rojo dejándome llevar por el tráfico (19# "I jump the red traffic light following the other traffic")	1 2 3 4 5 6
15	Espero pacientemente a que el tráfico pase en una intersección donde tengo que ceder el paso (31# "I wait patiently for the traffic to pass at an intersection where I don't have right of way") <sup>a</sup>	1 2 3 4 5 6
16	Disfruto del paisaje mientras conduzco (39# "I enjoy the landscape while driving")	1 2 3 4 5 6
17	Freno bruscamente para evitar un choque por ir distraído (17# "I am often distracted or preoccupied, and suddenly have to slam on the brakes to avoid a collision") <sup>a</sup>	1 2 3 4 5 6
18	Conduzco siguiendo el dicho "más vale prevenir que curar" (28# "I base my behaviour on the motto 'better safe than sorry'") <sup>a</sup>	1 2 3 4 5 6
19	Me siento estresado mientras conduzco (32# "I feel stressed while driving") <sup>a</sup>	1 2 3 4 5 6
20	Olvido que llevo puestas las luces largas (12# "I forget that my lights are on full beam") <sup>a</sup>	1 2 3 4 5 6
21	Discuto con otros conductores o peatones (21# "I argue with other drivers or pedestrians")	1 2 3 4 5 6
22	Me gusta asumir riesgos mientras conduzco (6# "I like to take risks while driving") <sup>a</sup>	1 2 3 4 5 6
23	Conduzco hacia un sitio distinto del que tenía intención de conducir (10# "I drive somewhere other than the intended destination")	1 2 3 4 5 6
24	Me siento nervioso mientras conduzco (33# "I feel nervous while driving") <sup>a</sup>	1 2 3 4 5 6
25	Me impaciento en horas punta (34# "I get impatient during the rush hours") <sup>a</sup>	1 2 3 4 5 6
26	Planeo mal la ruta y encuentro tráfico que podría haber evitado (13# "I plan my route badly, so that I hit traffic that I could have avoided") <sup>a</sup>	1 2 3 4 5 6
27	Espero pacientemente cuando no tengo prioridad (29# "I wait patiently when I don't have right of way")	1 2 3 4 5 6
28	Planeo los viajes largos con antelación (30# "I plan long journeys in advance") <sup>a</sup>	1 2 3 4 5 6
29	Casi choco por no calcular bien las distancias en un aparcamiento (15# "I nearly hit something due to misjudging the gap in a parking space") <sup>a</sup>	1 2 3 4 5 6
30	Mientras conduzco voy pensando y reflexionando (38# "I meditate while driving") <sup>a</sup>	1 2 3 4 5 6
31	Estoy preparado para reaccionar ante las maniobras inesperadas de otros conductores (27# "I'm ready to react to unexpected manoeuvres by other drivers") <sup>a</sup>	1 2 3 4 5 6
32	Suelo conducir con precaución (26# "I tend to drive carefully") <sup>a</sup>	1 2 3 4 5 6
33	Me enfado con personas que conducen lento en el carril rápido (22# "I get angry with people who drive slowly in the fast lane")	1 2 3 4 5 6
34	Disfruto de la conducción peligrosa (5# "I enjoy the excitement of dangerous driving") <sup>a</sup>	1 2 3 4 5 6

<sup>a</sup>Items that belong to the original version of the MDSI (Taubman – Ben-Ari et al., 2004)

# Number corresponding with the Argentinian version of MDSI (Poó et al., 2013).

**Questionnaire MDSI-Spain. Part II**

**Items y Factores del MDSI-Spain**

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Accident, Analysis and Prevention

DESADAPTATIVOS

2	Me pego a otros vehículos a propósito	TEMERARIO
4	Disfruto de la potencia del motor	
5	Disfruto de la sensación de conducir al límite	
7	Disfruto al cambiar de marcha con rapidez	
13	Siento que el vehículo pide más velocidad	
22	Me gusta asumir riesgos mientras conduzco	
34	Disfruto de la conducción peligrosa	
3	Toco a menudo la bocina o hago luces en señal de enfado	AGRESIVO
10	Insulto a otros conductores	
33	Me enfado con personas que conducen lento en el carril rápido	
21	Discuto con otros conductores o peatones	
8	Me produce frustración conducir	ANSIOSO
19	Me siento estresado mientras conduzco	
24	Me siento nervioso mientras conduzco	
25	Me impaciento en horas punta	
14	Me salto un semáforo en rojo dejándome llevar por el tráfico	DISTRAÍDO

9	Doy vueltas de más para llegar a un destino
12	Distraído no me doy cuenta de que un peatón está cruzando
17	Freno bruscamente para evitar un choque por ir distraído
20	Olvido que llevo puestas las luces largas
23	Conduzco hacia un sitio distinto del que tenía intención de conducir
26	Planeo mal la ruta y encuentro tráfico que podría haber evitado
29	Casi choco por no calcular bien las distancias en un aparcamiento

ADAPTATIVOS

11	Cuando se pone en verde el semáforo espero un momento a que arranque los vehículos que me preceden.	CAUTELOSO
15	Espero pacientemente a que el tráfico pase en una intersección donde tengo que ceder el paso	
18	Conduzco siguiendo el dicho “más vale prevenir que curar”	
27	Espero pacientemente cuando no tengo prioridad	
28	Planeo los viajes largos con antelación	
31	Estoy preparado para reaccionar ante las maniobras inesperadas de otros conductores	
32	Suelo conducir con precaución	
1	Escucho música y me relajo mientras conduzco	REDUCCIÓN DE ESTRÉS
6	Intento relajarme mientras conduzco	
16	Disfruto del paisaje mientras conduzco	
30	Mientras conduzco voy pensando y reflexionando	

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.aap.2019.105413>.

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