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Reliability and validity of a Spanish-language version of the multidimensional driving style inventory

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ABSTRACT

The Multidimensional Driving Style Inventory (MDSI) was originally built and validated in Israel to measure four broad dimensions of driving styles: Reckless, Angry, Anxious, and Careful. This research was designed to adapt and validate a Spanish version of the MDSI for the assessment of driving styles in Argentina, provide evidence for its external validity, and examine its proneness to social desirability responding. Two studies were conducted to fulfill these aims. Study 1 ($n = 642$) examined the MDSI's factor structure and internal consistency as well as item properties. It also tested the associations between the MDSI factors, on one hand, and socio-demographic variables and self-reported traffic crashes, on the other. Study 2 ($n = 258$) examined the relationship between driving styles and personality traits according to Zuckerman's Alternative Five-Factor Model. In addition, it explored socially desirable responding on the MDSI factors. Results from the two studies present convincing evidence for the validity and reliability of the MDSI, which has emerged as a useful tool for future research with Spanish speaking populations.

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1. Introduction

Taubman-Ben-Ari, Mikulincer, and Gillath (2004) made a valuable contribution to the field of traffic psychology by developing the Multidimensional Driving Style Inventory (MDSI). This paper expands on their effort by presenting a new Spanish-language version of the MDSI, and aims at: (a) assessing its reliability and validity in two samples of Argentine drivers; (b) analyzing the relations between personality traits and driving styles; and (c) examining the robustness of the MDSI against social desirability bias. In addition, the present work provides relevant information about risk groups as defined by driving styles and self-reported traffic crashes.

1.1. The multidimensional driving style inventory

The MDSI is a self-report measure developed to assess driving styles (Taubman-Ben-Ari et al., 2004). Driving style has been defined as the way an individual habitually drive, including selection of driving speed, compliance to rules, and levels

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of attentiveness and assertiveness (Elander, West, & French, 1993). Based on an extensive literature review, the MDSI's authors hypothesized four general kinds of driving as key dimensions of driving styles. The first dimension is the *reckless and careless driving*, which includes behaviors of seeking sensation and thrill while driving, and deliberately violating road safety norms. The MDSI includes two different styles for this general domain: the *risky style* and the *high-velocity style*. A second dimension is *anxious driving*, which reflects feelings of alertness and tension as well as ineffective engagement in relaxing activities during driving. This dimension is represented in the MDSI by the *anxious, dissociative* and *distress-reduction* styles. The *angry and hostile driving* domain is the third general dimension and it refers to the tendency to experience feelings of irritability and hostility while driving, as well as to act aggressively on the road. In this case the dimension is represented by a single style, named *angry driving*. Last is the *patient and careful driving* dimension which reflects a well-adjusted driving style, represented in the MDSI by two styles: *careful* and *patient*.

The MDSI was designed by adapting items from several existing driving measures such as the Driving Style Questionnaire (French, West, Elander, & Wilding, 1993), the Driver Behavior Questionnaire (Reason, Manstead, Stradling, Baxter, & Campbell, 1990), and the Driving Behavior Inventory (Gulian, Matthews, Glendon, Davies, & Debney, 1989), as well as the addition of original items. The final version included 44-items distributed across eight driving style factors that previous instruments used to measure as separate concepts (i.e. driving stress, driver aggression, risky driving). It also incorporated positive driving behaviors which had been mostly neglected in previous research; more specifically, the careful and patient styles. These qualities present a clear advantage when the MDSI is compared to other measures used in traffic psychology research.

The study by Taubman-Ben-Ari et al. (2004) reported several indicators of the MDSI's reliability and validity. The factors composing the eight styles showed Cronbach's Alpha values ranging from .72 to .86. Also, the MDSI scores were significantly associated with involvement in traffic crashes and driving offences. Thus, the *angry, risky* and *high-velocity* driving styles were positively and significantly associated with self-reports of vehicle crashes as well as with traffic offences, and the *careful* driving style was significantly related to less traffic crashes. Validity was further supported through several associations between MDSI's factors and socio-demographic variables. More specifically, women had higher scores than men on the anxious and dissociative styles, a finding which had been previously noted in the literature discussing driving stress (see for example: Ulleberg, 2002). In addition, maladaptive driving styles were negatively correlated with age, which is also in line with a host of previous findings (e.g., Jonah, 1986; Özkan & Lajunen, 2005a, 2006). More specifically, the younger the drivers are, higher their tendency to adopt *dissociative, angry, anxious, risky, or high velocity* driving styles and lower their tendency to adopt the *careful* and *patient* driving styles.

The MDSI's authors also provided evidence for the construct validity of their instrument through its correlation with personality traits. Six different variables were evaluated: self-esteem, desire for control, sensation seeking, extroversion, trait anxiety and neuroticism. Significant associations were found between each of these traits and driving styles. These results were consistent with previous data (e.g., Jonah, Thiessen, & Au-Yeng, 2001; Trimpop & Kirkcaldy, 1997), attesting for the MDSI's validity.

Further research was conducted to provide complementary evidence of the MDSI validity. Taubman-Ben-Ari (2006) reasoned that partners' reports could be employed to verify self-reports, as they are not based on the momentary impression of a specific driving performance, but on cumulative observations of the intimate partner in a wide range of driving situations, contexts, and personal circumstances. This study adopted a four factor solution for the MDSI, following its basic four domains: reckless, angry, anxious, and patient. Results revealed positively significant correlations between drivers' self-report and their partners' assessment of the same driving styles. These results allowed to control for self serving bias and provided additional evidence for MDSI's psychometric merits. In addition, significant gender differences were found in three driving styles. Men reported to be more engaged in reckless and angry driving as compared with women, whereas women displayed higher levels of anxious driving. Interestingly, Taubman-Ben-Ari (2006) found significant correlations among partners' scores which were interpreted as evidence for similarities in the couple driving styles. In another study, Taubman-Ben-Ari, Mikulincer, and Gillath (2005) found significant correlations between parents and offspring driving styles. These studies attested once again for the reliability of the MDSI's factors and for its utility and usefulness in traffic psychology research.

1.2. Driving styles and personality traits

Personality traits have been studied as predispositional factors for specific driving behaviors. Risky driving has been associated with sensation seeking (e.g., Schewebel, Severson, Ball, & Rizzo, 2006; Sümer, 2003) and, to a lesser extent, with other traits like impulsivity (Owsley, McGwin, & McNeal, 2003; Ryb, Dischinger, Kufera, & Read, 2006), aggression and anger (Schewebel et al., 2006; Stephens & Groeger, 2009; Ulleberg, 2002). Angry driving has also generated considerable research. Ample evidence exists on the relationship between anger and aggression-related traits and angry driving (e.g., Deffenbacher, Lynch, Oetting, & Yingling 2001; Krahé, 2005; Maxwell, Grant, & Lipkin, 2005; Nesbit, Conger, & Conger, 2007). Other personality traits have also been associated with driving anger; including sensation seeking (e.g., Dahlen & White, 2006; Jonah et al., 2001), neuroticism (Dahlen & White, 2006), and trait anxiety (Shahar, 2009). It is also known that some of these traits are closely related to anger and hostility. For example, neuroticism from the Big Five model (Costa & McCrae, 1988) includes emotional instability, anger, hostility and irritability. Type A behavior pattern was also associated with angry driving (Lajunen & Summala, 1995; Miles & Johnson, 2003) which could be explained by the implication of hostility, aggression and lack of patience in the Type A behavioral style.

Anxious driving style is another dimension that has been related to personality. Research has revealed relatively robust associations between neuroticism and reports of driving while anxious (Dorn & Matthews, 1992; Lajunen & Summala, 1995; Matthews, Dorn, & Glendon, 1991). Stephens and Groeger (2009) found that drivers who had higher scores on trait anxiety perceived higher difficulty in a driving simulation task. Trait anxiety has been also associated with the level of anxiety while driving in natural settings (Mesken, Hagenzieker, Rothengatter, & De Ward, 2007). In line with these findings, Taubman-Ben-Ari et al. (2004) found an inverse association between anxious driving style and extraversion. Taken together, these results suggest that high scores in neuroticism and trait anxiety predispose drivers to experience anxiety during driving.

Although the above mentioned researches associate driving styles with various personality traits, driving style has not been yet related to a comprehensive multidimensional personality model (e.g., The Big-Five Factor Model; Costa & McCrae, 1988, or The Alternative Big-Five Factor Model; Zuckerman, 2002). The common practice appears to be the selection of a specific domain of driving (e.g., risky driving) and the assessment of its associations with some specific personality trait (e.g., sensation seeking). Moreover, the relationships between personality and driving styles have been more studied for specific styles such as the risky and aggressive styles, while there is less and more contradictory evidence for other styles such as the anxious, dissociative, or careful and patient styles. Hence, it is difficult to have a comprehensive and coherent picture of the relationship between personality and driving behavior. Studies assessing both personality and driving styles from multidimensional models are therefore needed.

1.3. Social desirability

Self-report is a common method used for the assessment of psychological constructs, driving styles being no exception. However, they have some notable drawbacks. Of special interest is socially desirable responding, which may be defined as the tendency of individuals to project favorable images of themselves and misrepresent their answers as a consequence (Nunnally & Bernstein, 1994). The risk of obtaining distorted responses is higher when self-report measures ask about sensitive topics that may even be perceived by the responder as self-incriminatory, which could be the case for some driving behaviors. Thus the possibility of socially desirable biased responding by drivers' participating in traffic psychology self-report research should be statistically assessed and controlled.

Researchers have developed several ways to evaluate social desirability biases. For example, Lajunen, Corry, Summala, and Hartley (1997) designed an inventory called the Driver Social Desirability Scale (DSDS). However, the DSDS has not been frequently used. One problem of this scale seems to be the difficulty to determine whether it measures a social desirability bias or a highly prudent driving style. Hence, the use of more objective methods are still needed. An interesting alternative is to administer and compare the questionnaires in different situations that can induce different levels of bias. For example, Lajunen and Summala (2003) compared responses to the DBQ under anonymity vs. non-anonymity conditions. While Lajunen and Summala used a between-group design, Sullman and Taylor (2010) conducted a similar study but they used a repeated measure design. Despite this difference both studies reported no evidence for social desirable responding in traffic self-reports. This type of studies has not been conducted yet with the MDSI, and we think that it would be an appropriate approach to assess a potential social desirability bias.

1.4. Aims of the present research

It has been stated that driving-related behaviors are influenced by cultural and contextual factors that can vary from one culture to another (e.g., Nordfjærn & Rundmo, 2009; Özkan & Lajunen, 2011). Thus, the study of driving styles should consider culture-specific conditions in order to provide evidence for its external validity. Although the MDSI appears as a useful instrument to assess driving styles, and it has already been translated to other languages, there seems to be a lack of published studies assessing its properties in other languages and cultures. We were able to identify one such study: an adaptation of the MDSI into the Portuguese language in Brazil (Silva, 2004). However, the factor analysis of this version revealed a rather confusing structure which partially reflected the original one. Furthermore, we do not have information about the existence of any MDSI's version in Spanish. A reliable and valid version of MDSI in Latin America could be useful for conducting research on driving styles, as developments in the area are scarce. Thus, the first and foremost objective of the present work was to translate and validate the MDSI for its use with a Spanish-speaking population.

In addition, the MDSI is a relatively new measure and there is still little information regarding its reliability and validity except for in Israel. Also, as previously mentioned, the degree to which subjects' responses to the MDSI are influenced by social desirability bias is hardly known. Hence, a second objective for this study was to provide new evidence of reliability and validity for the MDSI. More specifically, we wanted to assess the relationship between driving styles and personality traits and the MDSI's robustness against social desirability bias. We adopted a comprehensive personality model for the current study and assessed relations between driving styles and Zuckerman's Alternative Five-Factor Model (AFFM) (Zuckerman, 2002). We found this model appropriate for the assessment of drivers because it is composed of five personality factors that somewhat maintain theoretical correspondence with driving styles and include one scale to assess Sensation Seeking, which is one of the most evaluated trait in the driver behavior literature.

The factors that compose the AFFM are: Impulsive Sensation-Seeking (ImpSS), Neuroticism-Anxiety (NANx), Aggression-Hostility (Agg-Host), Activity (Act) and Sociability (Sy). ImpSS is a complex trait that includes Impulsivity and Sensation Seeking. Impulsivity has been conceptualized as a lack of reflectiveness and planning, carelessness, and rapid decision-making

and action. Sensation seeking has been defined as the seeking of varied, novel, complex and intense sensations and experiences, and/or the willingness to take physical, social, legal and financial risk for the sake of such experience. Zuckerman (1994) comprises both in a single dimension as these have shown a strong positive correlation. *N-Anx* accounts for personality aspects related with the tendency to experience negative affective states, including feelings of anxiety and emotional distress, low mood, excessive worries, indecision, lack of confidence and sensitivity to criticism. *Agg-Host* implies the proneness to behave in an aggressive, rude and thoughtless manner, and to show an antisocial, vengeful and malicious behavior. *Act* refers to the individual's need to keep himself or herself continuously active and their preference for challenging tasks that require effort and dedication. *Sy* refers to the individual's predisposition to spend time with friends, being involved with others in recreational activities and the inability to be in solitude.

In accordance with our objectives, two studies were conducted. In Study 1, we present the development of a Spanish-language version of the MDSI where we analyzed (a) its factor structure and reliability, (b) potential differences in driving styles based on gender, age and other socio-descriptive variables, and (c) the associations among driving styles and self-reported traffic crashes and offenses. In Study 2, correlations between personality traits and driving styles, and possible effects of social desirability on MDSI' scores were evaluated.

2. Study 1

The aims of Study 1 were to adapt the MDSI for use in a Spanish speaking population and to assess some of its psychometric properties, including dimensionality and reliability. We expected a similar factor structure to that obtained in the original study and acceptable levels of reliability. However, we assumed the need of making some changes in the original version with the purpose of enhancing the MDSI's content validity in our context. Additionally, we wanted to assess differences in driving style based on gender and age. Despite the existence of previous studies documenting such differences in many places (e.g., Boyce & Geller, 2002; Shinar, Schechtman, & Compton, 2001), to the best of our knowledge, there are no such studies conducted with the Argentine population. Following Taubman-Ben-Ari et al. (2004), we expected women to score lower than men on risky and aggressive styles and higher on anxious and dissociative styles. We also hypothesized young drivers to score higher than adult drivers in risky and angry styles, and lower in the careful driving style. Finally, we expected the MDSI scales to discriminate between drivers reporting history of traffic crashes and those not reporting such history. In this regard, we hypothesized that drivers who reported traffic crashes and those reporting receiving traffic tickets would score higher on the risky, angry, dissociative, and anxious driving styles as well as lower in patient and careful driving styles than those without such reports.

2.1. Method

2.1.1. Participants

Six hundred and forty-two drivers from the general population in the city of Mar del Plata, Argentina, agreed to participate in the study. Data were collected over an 11-month period during 2008 and 2009. Inclusion criteria consisted of individuals with: (a) at least 18 year of age, (b) a valid driver's license, and (c) a driving frequency of at least once a week over the past 3 months. Participant's age ranged from 18 to 78 ($M = 38.9$, $SD = 13.7$). Men accounted for 58.7% of the sample. Most participants drove regularly (most days of the week) in their own or their family vehicles (78%). In regard to occupation, 41.5% of the sample consisted of public and private sector employees, 32.5% of business owners, professionals, and independent contractors, 12.5% of university students, and the remaining participants of mostly homemakers, retirees, and the unemployed. Most participants (88%) had an educational attainment of at least high school.

2.1.2. Measures

A self-report questionnaire was used to assess socio-demographic characteristics (e.g., gender, age, and education level), driving variables (e.g. type of driver's license, years of driving, and self reported traffic crashes and tickets in the last two years). Driving Styles were assessed by the MDSI-Spanish version (MDSI-S). The MDSI-S was developed upon the Spanish translation of the 44 original items and the addition of new 21-items developed for the Spanish version. Two bilingual researchers translated the original items separately. Another two researchers with knowledge in Traffic Psychology evaluated both versions of the scale. One of them was asked to evaluate the adequacy and clearness of the items in each version. The better version of each item was preserved. Then, the new items made for the Spanish version were added. After that, the second researcher was asked to classified items according to driving style dimensions. That is to say, that indicated which dimension or scale belongs. The 92.5% of the total items were classified in line with expectations.

The rationale for including new items was multifold. First, after evaluating items from the original version we noted that some of these items needed to be discarded as they reflected situations which did not apply at all, or only very infrequently to the socio-cultural and traffic context of the present study (e.g., "when in a traffic jam and the lane next to me starts to move, I try to move into that lane as soon as possible"). A second reason was a motivation to include traffic situations or idiosyncratic behavior than can be typical for the Argentine driver, but which were not present in the original version of the instrument (e.g., "let the other drivers to pass when I get to an intersection"). In sum, our aim was to provide higher content validity based on the Argentine socio-cultural driving context taking into consideration the various MDSI domains.

A pilot study ($n = 102$) confirmed our previous assumption and suggested the need for changes. Regarding new items, some were discarded while others were reworded for better reader comprehension. It is worth noting that a few original items that may have lacked socio-cultural equivalence in our context were kept in order to maintain as much correspondence as possible between the original and Spanish versions of the instrument. As in the original version, participants were asked to read each item and to rate the extent to which it reflected their feelings, thoughts, and behaviors during driving on a 6-point Likert scale, ranging from *–not at all* (1) to *–very much* (6).

2.1.3. Procedure

Participants were recruited by the researchers' team and psychology students who served as surveyors assisting with data collection. They approached drivers from the general population and asked for their consent to participate in the study. Participants were invited to collaborate without any compensation. All participants who were debriefed on the study's objectives, gave their verbal consent. The response rate was very high (>95%). Questionnaires were completed in an average time of fifteen minutes. Data management and analysis were performed using SPSS 11 and ViSta statistical software. When missing data were found, we used a pair-wise deletion method. The statistical analysis involved three phases: (a) factor analysis to assess the dimensionality of the MDSI (original inventory) and MDSI-S, (b) reliability analysis (internal consistency analysis) of the resulting factor scales, and corrected item-test discrimination index for each item, (c) Pearson correlation between MDSI-S's scales and between MDSI-S and MDSI original's scales, (d) a multivariate analysis of covariance (MANCOVA) to examine differences in the MDSI's scores due to socio-demographic variables (gender, age, educational level and years of driving experience.), and (e) a MANOVA to evaluate between-group differences in self-reported traffic crashes during the last two years (based on the subset of participants with two or more years of driving experience).

2.2. Results

2.2.1. Factor analysis and reliability analyses

First, the factor structure's robustness of the 44 original items was evaluated with a Confirmatory Factor Analysis (Estimation: Maximun Likelihood). The analysis indicates that the original model does not account well for the data. [$\text{Chi}^2(874) = 3225.2$, $p < .0001$, $\text{CMIN/DF} = 3.69$, $\text{CFI} = .687$, $\text{GFI} = .796$, $\text{AGFI} = .769$, $\text{RMSA} = .065$]. Second, an Exploratory Factor Analysis was performed to evaluate if an alternative factor structured emerged from the data. The analysis revealed the existence of seven factors which surpassed the PA criterion and accounted for 46% of the total variance ($\text{KMO} = 0.87$, Bartlett Test = 8472.65, $p < 0.001$): (1) 11 items that clearly correspond to the *dissociative style* (explained variance of 17.88%); (2) six items conforming to the *angry style* of the original MDSI (explained variance of 8.99%); (3) 13 items which explained 5.69% of the total variance and consists of some of the careful style and some of the risky style – with negative loading; (4) four items from the *distress reduction style* (explained variance of 4.06%); (5) four items from the *risky style* (explained variance of 3.50%); (6) two items related to traffic congestion situations (explained variance of 3.37%); and (7) two items relating to driving control (“I feel comfortable while driving” and “I feel I am in control of my driving”), which explained 3.17% of the variance. Overall, this result based on the 44 original items partially coincided with results obtained in the original studies in Israel. But some difficulties were noted: (a) five items had high factor loadings on more than one dimension, and six items did not load on any factor, (b) two retained factors consisted of only two items, and (c) only the first three factors had adequate levels of internal consistency (i.e. Cronbach's $\alpha > .70$).

Better results were obtained when we analyzed our extended version of the inventory (i.e. MDSI-S). In this case, parallel analysis suggested a 6-factor solution (Extraction: principal axis; Rotation: Oblimin). The factors were interpretable and explained 46.9% of the total variance ($\text{KMO} = 0.88$, Bartlett Test = 8355.45, $p < 0.001$, determinant = 1.626). Table 1 displays the factor loading of the items in each of the six factors. Items that showed factor loadings lower than .30 were discarded and therefore are not included in the table. The first factor accounts for 19.9% of the total variance and consists of nine items. This factor includes items from the risky and high velocity scales of the original MDSI. All these items refer to a person's seeking for stimulation and risk taking during driving. On this basis, we labeled this factor as *Risky driving style*. The second factor explains 10.06% of the variance, and contains ten items which correspond to the *Dissociative style* of the original measure. Items loading on this factor reflect a tendency to being distracted while driving and committing driving errors due to this distraction. The third factor explains 4.85% of the variance and includes six items, which make up the *Angry driving style*. Most representative items denote behaviors and feelings such as lack of patience towards other drivers and anger displays. The fourth factor explains 4.54% of the variance, and contains six items representing safe and careful driving attitudes and behaviors. It groups items from the original Careful and Patient driving styles; therefore, we have named this factor as *Careful driving style*. The fifth factor explains 4.05% of the variance, and includes four items, all from the original *Anxious style*. The most representative items denote feelings of distress and perceptions of inability to drive. Lastly, the sixth factor explains 3.4% of the variance, and groups five items which compose the *Distress Reduction* scale. This factor contains items which tap at the tendency to engage in activities which could reduce driving stress.

The final number of MDSI-S items totaled 40, from which 17 were from the Argentine additions. Factor analysis results from the local sample were used to calculate the total scores of the six resulting driving styles. We computed total factor scores by averaging the unweighted scores of items that loaded primarily on each factor. Table 2 shows summary statistics for the MDSI-S factors. All but one of the six factors (Distress Reduction) reached acceptable (>.70) Cronbach's alpha coefficients. Pearson correlations between the six factors revealed consistent and coherent patterns of association (see Table 3).

Table 1
Exploratory factor analysis of the MDSI-S items.

MDSI-S items	Factor loading						M	SD	Item test
	1	2	3	4	5	6			
<i>Risky style</i>									
1. Enjoy the sensation of driving on the limit ^a	.81						2.06	1.50	0.78
2. Enjoy the power of the engine.	.81						2.64	1.71	0.70
3. Enjoy shifting gears quickly	.79						2.53	1.65	0.74
4. Feel the car asking for more speed	.67						2.26	1.46	0.60
5. Enjoy the excitement of dangerous driving ^a	.59						1.57	1.13	0.62
6. Like to take risks while driving ^a	.48						1.63	1.24	0.52
7. Driving over the speed limit in the city	.39						2.66	1.42	0.60
8. Purposely tailgate other drivers ^a	.32						1.97	1.32	0.50
9. Drive faster when a vehicle is trying to pass me	.30			-.31			1.78	1.26	0.47
<i>Dissociative style</i>									
10. Driving somewhere else to other than the intended destination		.64					1.96	1.22	0.53
11. Drive away from traffic lights in third gear ^a		.66					1.61	0.96	0.56
12. Forget that my lights are on full beam ^a		.58					2.03	1.17	0.51
13. Plan my route badly, so that I hit traffic that I could have avoided ^a		.49					2.05	1.10	0.48
14. Switch on the lights instead of the windscreen wipers ^a		.47					1.63	1.06	0.47
15. Nearly hit something due to misjudging my gap in a parking lot ^a		.47					1.88	1.13	0.49
16. Taking a roundabout path to reach destination		.43					2.57	1.44	0.37
17. I am often distracted or preoccupied, and suddenly have to slam on the brakes to avoid a collision ^a		.38					1.99	1.12	0.45
18. Lost in thoughts or distracted, I fail to notice someone at the pedestrian crossings ^a		.33		-.32			1.95	1.08	0.49
19. Running a red light for going along traffic.		.31					1.99	1.13	0.38
<i>Angry Style</i>									
20. Swear at other drivers ^a			.75				2.50	1.58	0.64
21. Arguing with other drivers or pedestrians			.73				2.54	1.53	0.57
22. Get angry with people driving slow in the fast lane			.56				4.08	1.55	0.45
23. I often blow my horn or “flash” the car in front ^a			.52				2.82	1.64	0.53
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 ^a			-.38				3.68	1.49	0.38
25. Drive through traffic lights that have just turned red ^a			.30				2.87	1.42	0.40
<i>Careful style</i>									
26. Tend to drive cautiously ^a				.56			5.22	0.91	0.48
27. Ready to react to unexpected maneuvers by other drivers ^a				.53			4.71	1.19	0.28
28. I base my behavior on the motto “better safe than sorry” ^a				.48			4.85	1.33	0.42
29. Wait patiently when not having right of way				.43			5.00	1.03	0.37
30. I plan long journeys in advance ^a				.41			4.11	1.67	0.30
31. At an intersection were I have to give right of way to oncoming traffic, wait patiently for cross-traffic to pass ^a				.34			4.48	1.26	0.41
<i>Anxious style</i>									
32. Feel distressed while driving ^a					.83		2.11	1.23	0.66
33. Feel nervous while driving ^a					.63		1.76	1.10	0.54
34. To get impatient during rush hours ^a					.55		2.93	1.51	0.48
35. Driving makes me feel frustrated ^a					.37		1.41	0.85	0.37
<i>Distress reduction style</i>									
36. Listen to music to relax while driving						.54	3.48	1.23	0.40
37. I daydream to pass the time while driving ^a						.46	2.75	1.10	0.32
38. Meditate while driving ^a						.40	2.25	1.51	0.30
39. Enjoy the landscape while driving						.34	3.50	1.23	0.28
40. Do relaxing activities while driving ^a						.30	3.54	0.85	0.33

^a Items that belong to the original version of the MDSI.

With regards to Pearson correlations between MDSI-S and MDSI scales, moderate to high correlations were observed between conceptually equivalent styles (i.e. risky and risky, angry and angry); positive correlations between maladaptive styles of both instruments, and negative correlations between the maladaptive and adaptive styles (see Table 4).

2.2.2. MDSI-S and sociodemographic variables

A Multivariate Analysis of Covariance was performed to examine differences in the MDSI-S scores by gender, age, educational level and years of driving experience. The MANCOVA revealed significant differences for gender, $F(6,620) = 17.4$, $p < .001$, and age, $F(6,620) = 18.25$, $p < .001$. No differences were found for educational level. Univariate ANOVAs indicated that there were statistically significant gender differences in all the driving styles. An examination of group means (see Table 5) revealed that women scored higher than men on the dissociative, anxious, and careful driving styles. Men scored higher than women on the risky and angry driving styles. An Univariate ANOVA also revealed that the covariate age significantly correlated with risky, $F(1,625) = 30.14$, $p < .001$, angry, $F(1,625) = 75.38$, $p < .001$, careful, $F(1,625) = 16.72$, $p < .001$, and stress reduction, $F(1,625) = 22.432$, $p < .001$ driving styles. No relationships were found with anxious, $F(1,625) = 1.67$, $p > .05$, and dissociative, $F(1,625) = 0.65$, $p > .05$ driving styles. Pearson correlations showed that the covariate age correlated negatively with risky ($r = -.26$, $p < .001$), angry ($r = -.35$, $p < .001$), and stress reduction ($r = -.24$, $p < .001$) driving styles, and positively with the careful style ($r = .22$, $p < .001$).

2.2.3. MDSI-S factors and self-reported traffic crashes and offenses

Driving history variables were categorized as follows: (a) traffic crashes with only material damages (MD): No (61%), Yes (39%); (b) traffic crashes with human injuries (HI): No (93%), Yes (7%); (c) traffic offences (TO): none (79%), one (12%) or more than one (9%). The MANOVA revealed significant differences for MD, $F(6,552) = 5.80$, $p < .001$, and HI, $F(6,552) = 2.72$, $p < .05$, controlling for gender, age, educational level and years of driving experience. No statistically significant differences were found for TO, $F(12,1114) = 1.27$, $p > .05$. Univariate ANOVAs indicated that MD differences were significant in dissociative, $F(2,527) = 3.267$, $p < .05$, angry, $F(2,527) = 3.32$, $p < .05$, and careful, $F(2,527) = 4.24$, $p < .05$, driving styles. Univariate ANOVAs also indicated that HI differences were statistically significant for the risky, $F(2,527) = 7.70$, $p < .001$, and careful, $F(2,527) = 3.96$, $p < .05$ driving styles. Mean, standard deviation and effect size (Cohen's d) for each driving style are shown in Table 6.

2.3. Discussion

The results from this study suggest some content validity problems in the original MDSI version and thus the need for content changes and adaptations. After revising and expanding the content, a Spanish version (MDSI-S) emerged which results to some extent are equivalent to the original in the dimensions it assesses, but which possesses better psychometric properties. This result suggests that besides the existence of common indicators in both versions (original and adapted) some of them are clearly dependent on the context. Thus, the existence of instruments culturally valid for the assessment of driving behavior seems necessary, as has been mentioned by several authors before (cf. Nordfjærn & Rundmo, 2009; Özkan & Lajunen, 2011).

The results of the MDSI-S's exploratory factor analysis were consistent with the four theoretical dimensions (i.e. Risk, Anger, Anxious, and Careful) hypothesized by Taubman-Ben-Ari et al. (2004) and with versions from further studies (Taubman-Ben-Ari, 2006; Taubman-Ben-Ari & Yehil, 2012; Taubman-Ben-Ari et al., 2005). Furthermore, the six dimensions of the MDSI-S offer a comparable factorial solution to that of the original MDSI. The dissociative, angry, risky, careful, anxious, and distress reduction factors emerged and clearly coincide in both versions. The high velocity factor remained partially submerged into the risky factor and the patient factor in the careful factor. Notwithstanding the differences in the factorial results, the six-factor structure matches closely with the meaning of the four general domains originally proposed. Moreover, internal consistency levels for the resultant factors are acceptable.

The correlations between the six styles were also theoretically consistent and for the most part matched with that of the original study. Overall, it was observed that the maladaptive driving styles have positive correlations among them and negative correlations with the adaptive careful driving style. On the other hand, correlations between the Spanish and original versions were moderate to high, suggesting a significant degree of equivalence between both versions.

With regards to history of accidents, the maladaptive driving styles were associated with higher reports of traffic crashes. Thus, participants who reported involvement in traffic crashes obtained higher scores in the angry, dissociative and risky driving styles, as compared with participants who did not reported traffic crash involvement. In contrast, participants who reported that they had not been involved in crashes obtained higher scores on the careful driving style.

With regard to gender differences, women scored higher on the dissociative, anxious, and careful driving styles. These findings were expected and coincide with Taubman-Ben-Ari et al.'s (2004) results. We also found, in line with previous literature, that women scored lower on risky and angry driving styles (e.g., Lonczak, Neighbors, & Donovan, 2007; Özkan & Lajunen, 2005b). Regarding age, our results were also consistent with the original study and with previous research (Jonah, 1986; Taubman-Ben-Ari et al., 2004; Özkan & Lajunen, 2005a, 2006). Specifically, age was found to negatively correlate with risky, angry, and stress reduction styles. Contrary to results obtained in the original study, the anxious and dissociative driving styles were not associated with age in the present sample.

In summary, although the Spanish version of the MDSI partially differs from the original in content, results are generally consistent with those obtained by Taubman-Ben-Ari et al. (2004) and provide preliminary evidence of validity for the MDSI-S in the Argentine population.

3. Study 2

Study 2 was conducted to provide complementary evidence on the reliability and validity of the MDSI-S. First, following the study of Lajunen and Summala (2003), potential effects of social desirability bias were assessed. We assumed that under certain conditions participants show more socially desirable responses. We hypothesized higher levels of bias in face-to-face and non-anonymous conditions (in comparison with self-administration and anonymous conditions). Thus, if the responses to the MDSI-S are indeed biased by social desirability, then drivers will tend to score higher on the careful style, and lower on the risky and angry styles, in a situation which enhances this tendency. A second objective of this study was to present complementary evidence for construct validity of the MDSI-S. To do so, we analyzed the relations between the MDSI-S scores and personality traits according to the Alternative Five-Factor Model (AFFM). In accordance with the trait-definitions and previous literature (see Introduction) we hypothesized the following: (a) ImpSS will correlate positively with the risky and angry driving styles, and negatively with the careful driving style; (b) N-Anx will correlate positively with the anxious, dissociative, and distress reduction driving styles; and (c) Agg-Host will correlate positively with the angry and risky driving styles, and negatively with the careful driving style.

3.1. Method

3.1.1. Participants

Data was collected from a non-probabilistic sample consisting on 258 drivers (51.1% men, Age Mean = 35.2 years, SD = 13.3) in the city of Mar del Plata during 2009. The sample selection criteria were the same as in Study 1. Most participants drove regularly (most days of the week) in their own vehicles or those of family members (72%). Thirty-nine percent of the sample consisted of business owners, professionals, and independent contractors, 34% public and private sector employees, 29% of students, and the remaining participants of mostly homemakers and retirees. Most participants (82%) had an educational attainment of at least high school.

3.1.2. Measures

Personality traits were assessed with the Spanish version of the ZQPQ-50-cc, a short form of the Zuckerman–Kuhlman Personality Inventory (Aluja et al., 2006). The ZKPQ-50-cc consists of 50 true–false items measuring the five dimensions of the AFFM (ImpSS, N-Anx, Agg-Host, Act, and Sy). In the present sample, an Exploratory Factor Analysis of the ZQPQ-50-cc revealed five factors in accordance with the AFFM. Cronbach's alphas for the scales ranged from .72 to .81. Driving styles were assessed by the MDSI-S as described in Study 1. Socio-demographic details were gathered as described in Study 1. Summary statistics for ZKPQs' factors are shown in Table 7.

3.1.3. Procedure

The recruitment procedure of participants was similar to that in Study 1, except that the MDSI was administered in different conditions. A 2×2 quasi-experimental factor design was used to assess possible effects of social desirability bias. The first manipulated factor was the type of administration used (self-administration vs. face-to-face administration). In the face-to-face administration, questionnaires were read and administered by a surveyor. The second factor, replicating Lajunen and Summala (2003), referred to the anonymity of responses. In the anonymous condition, no names were required from participants, as compared with the first and last names requested in the non-anonymous condition. Our plan was to collect a sub-sample of 120 subjects for the face-to-face and non-anonymous condition (since it consists of two aspects which may influence social-desirable responding), and another sub-sample of 120 participants distributed across the remaining three conditions. The actual number of participants for each condition was: (a) Self administered/anonymous: 44; (b) Self-administered/non-anonymous: 49; (c) Face to face/anonymous: 47; (d) Face to face/non-anonymous: 118. The MDSI-S, ZKPQ-50-cc and the socio-demographic questionnaire were administered jointly. Questionnaires were completed in an average time of 20 min.

Table 2

Summary statistics for the MDSI-S factors.

MDSI-S factors	Number of items	Cronbach's alpha	Min	Max	Mean	SD	Assimetry	Kurtosis
Risky	9	.88	1	5	1.92	.92	1.00	.36
Dissociative	10	.81	1	5	1.95	.68	1.00	1.19
Angry	6	.80	1	6	3.02	1.08	.41	–.48
Anxious	4	.71	1	6	2.06	.88	–.62	.25
Careful	6	.70	2	6	4.76	.74	.78	.26
Distress Reduction	5	.59	1	6	3.10	.96	.03	–.43

Table 3
Correlation matrix for the MDSI-S factors.

	Dissociative	Angry	Careful	Anxious	Distress Reduction
Risky	.20**	.57**	-.41**	.11**	.31**
Dissociative		.23**	-.31**	.46**	.31**
Angry			-.39**	.14**	.23**
Careful				-.16**	-.14**
Anxious					.17**

** $p < .001$.

Table 4
Correlations between MDSI-S and MDSI's scales.

MDSI-S	MDSI							
	Dissociative	Anxious	Risky	Angry	High velocity	Distress Reduction	Patient	Careful
Risky	.21**	-.04	.82**	.49**	.58**	.10**	-.43(**)	-.49**
Dissociative	.89**	.19**	.28**	.22**	.26**	.24**	-.18(**)	-.52**
Angry	.23**	-.02	.45**	.86**	.64**	.02	-.44(**)	-.41**
Careful	-.29**	.10*	-.49**	-.43**	-.39**	.03	.87(**)	.69**
Anxious	.44**	.56**	.13**	.19**	.34**	.20**	-.05	-.25**
Distress Reduction	.43**	.01	.25**	.25**	.31**	.67**	-.10**	-.24**

** $p < 0.01$.

* $p < 0.05$ (bilateral).

Table 5
Means of the MDSI-S scales by gender.

MDSI-S factors	Gender	Mean	SD	$F(1,621)$	Cohen's d
Risky	Women	1.64	0.87	49.81***	-.51
	Men	2.13	1.02		
Dissociative	Women	2.09	0.75	16.62***	.37
	Men	1.84	0.61		
Angry	Women	2.83	0.95	16.64***	-.35
	Men	3.16	0.94		
Careful	Women	4.82	0.97	4.92*	.13
	Men	4.69	1.08		
Anxious	Women	2.20	0.88	12.07***	.33
	Men	1.91	0.85		
Distress reduction	Women	2.98	0.95	4.50*	-.17
	Men	3.15	0.96		

*** $p < .001$.

* $p < .05$.

Table 6
Mean, standard deviations and Cohen's d for driving styles according to driving history variables.

Driving styles	Material damages					Human injuries				
	No (61%)		Yes (39%)			No (93%)		Yes (7%)		
	M	SD	M	SD	Cohen's d	M	SD	M	SD	Cohen's d
Dissociative	2.0	.99	2.3	1.1	-.29					
Angry	2.8	1.1	3.3	1.1	-.45					
Careful	4.7	.65	4.4	.74	.43	4.6	.68	4.2	.76	.55
Risky						2.1	1.0	2.8	1.3	-.60

3.2. Results

A MANOVA was used to analyze the possible effects of administration conditions on the MDSI-S scores (Means and SD are showed in Table 8). The multivariate analysis revealed no significant differences among "face to face vs. self-administered" conditions, $F(6, 246) = 1.85, p > 0.05$, nor for the "anonymous vs. non-anonymous conditions", $F(6, 246) = 2.03, p > 0.05$. Also, there was no interaction effect $F(6, 246) = 0.98, p > 0.05$. In other words, we found no clues for social desirability biases for the MDSI-S. Pearson and partial correlations (controlling for age, gender, educational level and years of driving) between the

MDSI-S scales and the personality measures are shown on Table 9. Overall, the results suggest a pattern of relationships between personality traits and driving styles that are in accordance with our hypothesis. Impulsive Sensation Seeking correlated positively with risky and angry driving styles, and negatively with the careful driving style. Trait anxiety correlated positively with the dissociative, anxious, and distress reduction driving styles; and aggression correlated positively with the angry and risky styles, and negatively with the careful driving style.

3.3. Discussion

Study 2 provides complementary evidence for the validity of the MDSI-S. A first contribution of this study is the MDSI-S' robustness against social desirability bias. In theory, it could be argued that face to face and non-anonymous administration conditions could contribute towards higher social desirability and consequently affect MDSI responses. On the contrary, our results demonstrated no statistically significant mean differences among administration conditions. We interpret this result as evidence of the MDSI-S' robustness against the social desirability bias. However, it should be noted that each participant was informed that their responses would be solely used for research purposes and was assured the information given was confidential. Therefore, these results should only be interpreted in the context of research administrations of the scale.

With regards to the relationship between driving styles and personality traits, results are consistent with our hypothesis and in line with previous literature (Taubman-Ben-Ari et al., 2004). Impulsive Sensation Seeking correlated positively with risky and angry driving styles, and negatively with the careful driving style. It also showed a modest correlation with the dissociative driving style. This relationship could be attributed to the impulsivity aspect of the trait that seems to negatively affect cognitive processes. The Anxiety aspect of personality correlated positively with the dissociative and anxious driving styles, which is in line with findings from previous studies (e.g., Dorn & Matthews, 1992; Lajunen & Summala, 1995; Matthews et al., 1991). This finding suggests that trait anxiety might underlie both driving styles, which, in a way, can explain the correlation found between these two scales. Furthermore, this result justifies the possibility of combining both factors in one global factor called anxious driving, just like Taubman-Ben-Ari and her colleagues (Taubman-Ben-Ari, 2006; Taubman-Ben-Ari et al., 2005) did. Nevertheless, results also suggest some differences in the pattern of associations between the personality traits and each of these driving styles. For example, ImpSS was related with dissociative driving style, but not with the anxious style. On the other hand, Agg-Host was related to anxious driving style, yet not with the dissociative style. This may indicate that the underlying personality orientation for the two styles is not equivalent. Hence, keeping both scales separate would allow an accurate differentiation of drivers, which could be useful in the development of prevention measures targeted at specific groups of drivers.

As expected, the Aggressive-Hostility personality trait showed strong and positive correlations with the angry driving style. This is in line with previous literature which suggests a significant association between trait aggression and driving anger (Deffenbacher et al., 2001; Krahé, 2005). In addition, as hypothesized, this trait correlated positively with the risky driving style and negatively with the careful driving style. Another finding was a modest and negative correlation between Aggressive-Hostility trait and the distress reduction driving style, suggesting that those who are more hostile need less distress reduction actions as they are not anxious/stressed. Also it would indicate that anger driving is not only motivated by frustration or stress.

4. General discussion and conclusion

Results from our studies suggest satisfactory psychometric properties for the MDSI-S in Argentina with regard to both internal structure and external validity. As compared with the original version, the Spanish-language version developed in our studies has higher content validity for local context; yet it does not present with any significant changes as compared conceptually with the original scale. These scale properties were achieved through elimination of some of the original MDSI items and the addition of new ones. Also, the MDSI-S included two different scale aggregations. Notwithstanding these changes, the instrument has adequate correspondence with the main driving style domains (risky, angry, anxious, and careful) presented in the original measure design. Moreover, in further studies in Israel the author of the MDSI (Taubman-Ben-Ari, 2006; Taubman-Ben-Ari & Yehil, 2012) used a factor solution in which risky and high velocity driving styles were merged together to represent the reckless style and careful and patient factors were also merged together to compose the careful style.

Table 7

Summary statistics for ZKPQ factors.

ZKPQ factors	Number of items	Min	Max	Mean	SD	Assimetry	Kurtosis
N-Anx	10	0	10	3.54	2.37	.52	-.36
ImpSS	10	0	10	4.88	2.43	-.01	-.75
Act	10	0	10	4.85	2.93	.03	-1.20
Agg-Host	10	0	10	5.06	2.65	-.02	-.99
Sy	10	0	10	4.91	2.64	-.04	-.89

Table 8

Means and SD of the MDSI-S scales by administration conditions.

Administration Condition	MDSI-S scale											
	Risky		Angry		Anxious		Dissociative		Careful		Distress reduction	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Face-to-face/non-anonymous	1.99	.97	2.63	.95	2.08	.79	2.15	.73	4.06	.59	3.16	1.01
Face-to-face/anonymous	1.83	.86	2.63	.87	2.32	.93	2.30	.75	4.20	.55	3.13	.95
Self-administration/anonymous	1.71	.78	2.37	.78	1.99	.72	2.06	.65	4.46	.44	3.13	.83
Self-administration/non-anonymous	1.97	.94	2.38	.91	2.19	.77	2.12	.68	4.22	.55	3.32	1.05

Note: MANOVA summary: Factor 1 (Face to face/self-administered), $F(6,246) = 1.85$, $p > 0.05$; Factor 2 (Anonymous vs. non-anonymous), $F(6,246) = 2.03$, $p > 0.05$; Interaction effect, $F(6,246) = 0.98$, $p > 0.05$.

Table 9

Pearson and partial correlations between MDSI-S and ZKPQ scores.

	N-Anx	ImpSS	Act	Agg-Host	Sy
Risky ^a	.11	.34**	.08	.27**	.07
	.14	.21**	.07	.18*	.07
Dissociative ^a	.31**	.28**	-.08	.02	.11
	.31**	.30**	.005	.006	.08
Angry ^a	.03	.35**	.02	.46**	.01
	.04	.26**	.07	.35**	.02
Careful ^a	-.03	-.24**	.05	-.32**	-.05
	-.03	-.22**	.10	-.13	-.05
Anxious ^a	.31**	.08	-.12*	.18**	-.01
	.35**	.06	.02	.10	.05
Distress reduction ^a	.16*	.20**	.03	-.05	.03
	.04	.09	-.01	-.001	.10

** $p < .01$.* $p < .05$.^a Pearson correlations in the first row and partial correlations (controlling for age, gender, educational level, and years of driving) in the second row.

Correlations between MDSI-S scores, gender and age differences, and relationship with road crash involvement were found to be quite similar to that of the original study by Taubman-Ben-Ari et al. (2004), and were consistent with previous literature. Moreover, correlations between personality traits and driving styles were also theoretically consistent, providing evidence for construct validity of the MDSI-S. Notwithstanding this, in all cases correlations were moderate, suggesting that driver behavior could not be totally explained by personality traits. Further research is needed in order to identify psychological variables contributing to individual differences in driving styles.

Another important result is that the MDSI-S appears robust against social desirability when used in a research context. This finding is consistent with what has been reported regarding the effects of social desirability in traffic self reports (Lajunen et al. 1997; Sullman & Taylor, 2010). The procedure used in this study was similar to the one used by Lajunen et al. (1997) which consisted in varying anonymity in different administrations' conditions. Another way to control for social desirability bias is the use of statistical remedies such as partial correlation techniques (see Podsakoff, McKenzie, Lee, & Podsakoff, 2003). Statistical techniques could be very useful if the researcher clearly identifies the source of bias and has a measure of it. However, statistical techniques also have different drawbacks that should be carefully evaluated before their use (see Podsakoff et al., 2003). On the other hand, there are other possible response biases and distortions that were not evaluated in the two studies presented here. We suggest that future research should include convergent validity with other methodologies (e.g. naturalistic observation, driving simulation, traffic crashes records and driving infractions).

Since the MDSI is a rather new measure, further studies are needed in order to validate it in other contexts and cultures. Results from the studies presented here suggest that the original version of the instrument may not be adequate for cultural contexts different from those present in its validation studies. However, with modifications of content, a conceptually similar instrument can be developed. Culturally-sensitive translation and adaptation of the MDSI to other languages will enable cross-cultural comparison studies in the future. For this purpose, it would be important to have additional knowledge on the conceptual foundations of the MDSI. This could be accomplished through comparative studies with other models and instruments such as the DBQ, DBI or DSQ. This type of study has not been reported other than that of Westerman and Haighey's (2000) comparison of the DBQ and DBI.

In summary, the results of the current two studies provide evidence in support of the reliability and validity of MDSI-S. We believe we are offering a valuable human factors research tool for use in Spanish-speaking countries; particularly in Latin America where notwithstanding the high road traffic injury rates, research continues to be scarce and fragmented. The MDSI-S could help identify at risk groups and behaviors, as well as the socio-demographic and psychological factors associated with them.

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