DRIVER RISK-PERCEPTION IN SPAIN AND THE USA

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16. Abstract

This study investigated differences in risk-perception between Spanish and U.S. drivers. Subjects estimated the risk involved in slides of traffic scenes. The slides, photographed in both Spain and the U.S.A., were rated for the amount of risk by using a seven-point scale. The subject groups in each country included younger, middle-aged, and older non-professional drivers, as well as middle-aged professional (bus, taxi, or truck) drivers. The data were analyzed by multiple regressions, using mean risk-ratings for each combination of slide, culture, subject group, and sex as the dependent variable. The independent variables included culture, subject group, sex, 23 dichotomously coded characteristics of the traffic scene, and the respective first-order interactions.

The following are the main findings: (1) Spanish drivers reported higher levels of risk than did U.S. drivers for the same traffic scenes. (2) Younger drivers tended to report lower risk than did middle-aged drivers. (3) Professional drivers, especially in the U.S.A., tended to report more risk than did non-professional drivers of the same age. (4) Culture, subject group, and sex accounted for 34.4% of the variance in risk-ratings. (5) The characteristics of traffic scenes (such as uncertainty, lane intrusion, and preview distance) accounted for an additional 15.2% of the variance. (6) Interactions of culture, subject group, and sex with the characteristics of traffic scenes accounted for an additional 4.1% of the variance. (7) Among the interactions with the characteristics of the scenes, U.S. drivers rated potential need for quick action as resulting in greater risk, while Spanish drivers were unaffected by this parameter. Conversely, Spanish drivers rated higher speed as being more risky than lower speed, while the risk estimates of U.S. drivers were unaffected by speed. (8) A total of 53.7% of the variance in risk-ratings can be accounted for by the studied independent variables and their first-order interactions.

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CONTENTS

INTRODUCTION

This is the second in a series of studies being performed as part of a research project on driver risk-taking in Spain and the U.S.A. The first study (Sivak and Soler, 1986) involved an analysis of factors associated with traffic accidents in Spain and the U.S.A.

The present study investigated perception of risk in slides of traffic scenes. The primary objectives were to study (a) cross-cultural and age differences in the absolute level of perceived risk, and (b) cross-cultural and age differences in factors affecting perceived risk. The underlying rationale for this study was an attempt to identify risk-perception factors that differentially affect accident etiology in the two countries.

METHOD

Stimuli

One hundred color slides of traffic scenes were used. Fifty were taken in the U.S.A. from the driver's viewpoint. Fifty were taken in Spain and most of them were overviews of traffic scenes and were taken from sidewalks, bridges, etc. These slides were selected from a larger set of approximately 500 slides to represent a variety of driving situations under a range of conditions. An attempt was made to avoid slides containing traffic signs unique to one of the two countries. Copies of the same slides were used both in Spain and the U.S.A.

Each slide was coded on 23 dichotomous characteristics (Table 1). (For the U.S. slides, subjects were given explicit information about one of these characteristics—speed [see Procedure], while for the Spanish slides, the coding of speed was based on presumed traffic speed given the depicted situation.) The intercorrelations among these 23 variables were generally low. The distribution of these correlations is shown in Table 2.

TABLE 1
CHARACTERISTICS CODED FOR EACH INDIVIDUAL SLIDE

Variable	Binary Code	
	1	0
Ambient Illumination	Day	Night
Preview Distance	Sufficient	Insufficient
Following Distance	Sufficient	Insufficient
Lane Intrusion	No	Yes
Straight Roadway	Yes	No
Level Roadway	Yes	No
Environment	Rural	Urban
Limited Access Roadway	Yes	No
Weather	Good	Poor
Stopped Vehicle in the Lane	No	Yes
Traffic Density	Low	High
Road Delineation	Good	Poor
Animals	Absent	Present
Pedestrians or Bicyclists	Absent	Present
Speed	Under 90 km/hr	90 km/hr or over
Road Surface Friction	High	Low
Bridge or Tunnel	No	Yes
Country of the Slide	U.S.A.	Spain
Complexity	Low	High
Overtaking	No	Yes
Intersection	No	Yes
Quick Action	No Need	Potential Need
Uncertainty	Low	High

TABLE 2
DISTRIBUTION OF THE ABSOLUTE VALUES OF
THE INTERCORRELATIONS AMONG THE 23 SLIDE CHARACTERISTICS

Range		Frequency
Minimum	Maximum	
.000	.099	104
.100	.199	96
.200	.299	29
.300	.399	13
.400	.499	6
.500	.599	5

Subjects

A total of 160 subjects participated in this study. Eighty were tested in Spain and eighty in the U.S.A. There were 20 subjects (10 males and 10 females) in both Spain and the U.S.A. in each of the following four groups: 18–21 year olds, 35–45 year olds, 65–75 year olds, and 35–45 year old professional (bus, taxi, or truck) drivers. The actual ages of subjects in each group are shown in Table 3. The U.S. subjects, who were paid for their participation, came primarily from Ann Arbor, a city with a population of approximately 120,000. The Spanish subjects, who were unpaid volunteers, came primarily from Valencia, a city with a population of approximately 800,000.

TABLE 3
AGES OF SUBJECTS

Group	Culture	Sex	N	Min Age	Max Age	Mean Age
Younger	Spain	Males	10	19	21	19.9
		Females	10	19	21	20.4
	U.S.A.	Males	10	18	21	19.9
		Females	10	18	21	19.0
Middle-Aged	Spain	Males	10	35	45	39.5
		Females	10	35	45	40.4
	U.S.A.	Males	10	35	45	40.0
		Females	10	35	44	38.9
Older	Spain	Males	10	66	75	70.1
		Females	10	65	75	68.7
	U.S.A.	Males	10	66	75	70.6
		Females	10	68	75	71.4
Middle-Aged Professional	Spain	Males	10	35	45	39.5
		Females	10	35	45	39.7
	U.S.A.	Males	10	35	45	38.6
		Females	10	35	45	38.1

Procedure

Each slide was presented for about 20 seconds. The subjects were asked to evaluate the risk involved in the slides by using a seven-point scale. The scale had two anchor points (1 = minimum risk, 7 = high likelihood of an accident). The remaining points (2 through 6) were unlabelled.

For the U.S. slides (which were taken from the driver's view point), the subjects were given information about their speed (25, 40, or 55 mph [40, 65, or 90 km/h]). Thus, if the speed was given as 55 mph [90 km/h], they were asked to assume that *they* are driving at 55 mph [90 km/h], and that the traffic situation ahead is as shown in the slide. For the Spanish slides (which generally were not taken from the driver's viewpoint but were overviews of a situation), no speed information was given.

The slides were shown always in the same order, with the 50 U.S. slides first, followed by the 50 Spanish slides. No practice slides were given.

The wording of the subject's instructions was the same in both countries.

Statistical Considerations

The data were analyzed by the use of multiple regressions. The basic units for the analyses were the mean risk-ratings for each combination of slide, culture, subject group, and sex of the subject. Of interest, therefore, were the mean risk-ratings of groups of (ten) subjects and not the risk-ratings of the individual subjects. Consequently, the tests of significance in the regression analyses should be taken with caution, since the mean ratings were treated as individual data points. An additional reason for caution in the interpretation of statistically significant results is the fact that the risk-ratings for the 100 slides were not independent (as assumed by the regression analysis), but correlated since they came from the same subjects.

Because of these considerations, the percent of variance accounted for (r^2) is a more meaningful measure of the predictive power of the variables (and interactions) under investigation. Therefore, the variance accounted for is used as a critical measure in this report.

RESULTS

The mean ratings across all 100 slides are shown in Table 4. These results indicate that Spanish drivers tended to rate the traffic scenes as more risky than did U.S. drivers. Furthermore, older as well as more experienced drivers tended to rate the traffic scenes as more risky than did younger drivers. The distribution of the cross-cultural differences in the mean ratings of the individual slides is shown in Table 5.

To investigate the potential differential effects of the slide variables on driver risk-perception in Spain and the U.S.A., three multiple regression analyses were performed. In all three of these analyses, the dependent variable was the mean risk-rating of each slide for the ten subjects in each combination of culture × subject group × sex. (All three of these analyses were based on 98 slides; two slides [involving alcohol and sleep] could not be coded according to the characteristics in Table 1.)

The first multiple regression used culture, subject group, and sex as independent variables. (The group variable was entered in the form of three dummy variables [younger, middle-aged professional, and older], with the remaining group [middle-aged] forming the baseline.) The results for the standardized variables are shown in Table 6. (The entries are in the decreasing order of beta weights.) These results indicate that 34.4% of the variance in the risk-ratings can be accounted for by culture, subject group, and sex. The directions of the significant effects are shown in Table 7.

The second multiple regression used all slide variables as "free" independent variables, and culture, (dummy) subject groups, and sex as "fixed" independent variables. The results for the standardized variables are shown in Table 8. (Again, the entries are in the decreasing order of beta weights.) These results indicate that 49.6% of the variance in the risk-ratings of the slides can be accounted for by the slide variables, culture, subject group, and sex. (Culture, subject group, and sex accounted for 34.4% of the variance [Table 6]. Consequently, the slide variables accounted for an additional 15.2% of the variance.) The directions of the significant effects are listed in Table 9. All significant effects were in the expected direction, except for complexity, animals, pedestrians/bicyclists, and tunnel/bridge. (The effects of complexity and animals in the unexpected directions were evident only in a multivariate analysis: When bivariate relationships were examined, these effects were in the expected directions. Furthermore, the effect of animals in the multiple regression turned out to be the result of an interaction; see below.)

The third multiple regression used culture, subject group, sex, and all slide characteristics as "fixed" independent variables, and interaction terms as "free" independent variables. The interactions were formed by multiplying all slide variables by culture, sex, and (dummy) group variables, respectively. The results for the standardized variables are shown in Table 10. (The first entries are the significant interactions in the decreasing order of beta weights, followed by main effects in the decreasing order of beta weights.) These results indicate that out of the total set of 122 interactions (23 slide variables × culture, sex, and three [dummy] group variables; culture × sex; culture × group; and sex × group), 11 proved to be significant at the 0.05 level. (Based on chance alone, six interactions [5% of 122] would be expected to be significant at the 0.05 level.) The total variance accounted for by the significant interactions and by the main effects of all slide variables, culture, sex, and group amounted to 53.7%. (The main effects accounted for 49.6% [Table 8]. Consequently, the interactions accounted for an additional 4.1% of the variance.) The interpretations of the significant interactions are listed in Table 11.

TABLE 4
MEAN RATINGS FOR ALL 100 SLIDES BY CULTURE, SUBJECT GROUP, AND SEX
(1 = minimum risk; 7 = high likelihood of an accident;
standard deviations are in parentheses)

Group	Culture	Sex		Mean
		Male	Female	
Younger	Spain	4.8 (1.5)	4.1 (1.3)	4.5 (1.3)
	U.S.A.	3.4 (1.0)	3.8 (1.1)	3.6 (1.0)
Middle-Aged	Spain	4.9 (1.4)	4.9 (1.3)	4.9 (1.3)
	U.S.A.	4.1 (1.2)	3.8 (1.3)	3.9 (1.2)
Older	Spain	4.8 (1.4)	5.2 (1.3)	5.0 (1.3)
	U.S.A.	4.0 (1.1)	4.4 (1.2)	4.2 (1.1)
Middle-Aged Professional	Spain	5.1 (1.2)	4.8 (1.2)	4.9 (1.2)
	U.S.A.	4.5 (1.2)	4.4 (1.1)	4.4 (1.1)
Mean	Spain	4.9 (1.3)	4.8 (1.2)	4.8 (1.2)
	U.S.A.	4.0 (1.1)	4.1 (1.1)	4.0 (1.1)

TABLE 5
CULTURAL DIFFERENCES IN THE MEAN RISK
RATINGS OF THE INDIVIDUAL SLIDES
(negative difference: the slide was rated more risky in Spain;
positive difference: the slide was rated more risky in the U.S.A.)

Range		Frequency
Minimum	Maximum	
−3.500	−3.001	1
−3.000	−2.501	2
−2.500	−2.001	2
−2.000	−1.501	13
−1.500	−1.001	21
−1.000	−0.501	18
−0.500	−0.001	32
0	0	0
0.001	0.500	6
0.501	1.000	5

TABLE 6
LEAST SQUARES REGRESSION USING A SUBSET OF THE MAIN EFFECTS

Slide Variable	Beta Weight	Standard Error	T-stat	Signif
Culture	.291	.024	12.233	<.001
Younger Drivers	−.115	.029	−3.951	<.001
Professional Drivers	.092	.029	3.170	.002
Older Drivers	.065	.029	2.240	.025
Sex	−.007	.024	−.304	.761

$r^2 = .344$

TABLE 7
DIRECTIONS OF THE SIGNIFICANT MAIN EFFECTS FROM TABLE 6

Variable	Code Resulting in Increased Risk Rating
Culture	Spain
Younger Drivers *	No
Professional Drivers *	Yes
Older Drivers *	Yes

* Middle-Aged Drivers Being the Baseline

TABLE 8
LEAST SQUARES REGRESSION USING ALL MAIN EFFECTS ONLY

Slide Variable	Beta Weight	Standard Error	T-stat	Signif
Culture	.291	.018	16.056	<.001
Uncertainty	−.223	.027	−8.227	<.001
Lane Intrusion	−.196	.026	−7.531	<.001
Complexity	.183	.028	6.544	<.001
Following Distance	−.162	.022	−7.229	<.001
Preview Distance	−.149	.027	−5.557	<.001
Limited Access	−.148	.021	−6.983	<.001
Environment	−.142	.028	−5.125	<.001
Intersection	−.126	.025	−5.012	<.001
Animals	.119	.022	5.326	<.001
Younger Drivers	−.115	.022	−5.186	<.001
Weather	−.114	.025	−4.599	<.001
Pedestrians or Bicyclists	.111	.024	4.643	<.001
Quick Action	−.110	.025	−4.330	<.001
Road Surface Friction	−.097	.023	−4.270	<.001
Tunnel or Bridge	.095	.020	4.722	<.001
Professional Drivers	.092	.022	4.161	<.001
Level Roadway	−.080	.022	−3.654	<.001
Speed	−.078	.025	−3.198	.001
Country of Slide	−.075	.024	−3.145	.002
Older Drivers	.065	.022	2.940	.003
Straight Roadway	−.055	.025	−2.254	.024
Road Delineation	−.054	.033	−1.610	.108
Traffic Density	−.037	.022	−1.644	.100
Stopped Vehicle in the Lane	−.024	.021	−1.142	.254
Overtaking	.018	.022	.798	.425
Sex	−.007	.018	−.400	.690
Ambient Illumination	−.002	.025	−.089	.929

$r^2 = .496$

TABLE 9
DIRECTIONS OF THE SIGNIFICANT
MAIN EFFECTS FROM TABLE 8

Variable	Code Resulting in Increased Risk Rating
Culture	Spain
Uncertainty	High
Lane Intrusion	Yes
Complexity	Low
Following Distance	Insufficient
Preview Distance	Insufficient
Limited Access	No
Environment	Urban
Intersection	Yes
Animals	Absent
Young Drivers *	No
Weather	Poor
Pedestrians or Bicyclists	Absent
Quick Action	Potential Need
Road Surface Friction	Low
Tunnel or Bridge	No
Professional Drivers *	Yes
Level Roadway	No
Speed	90 km/hr or over
Country of Slide	Spain
Older Drivers *	Yes
Straight Roadway	No

* Middle-Aged Drivers Being the Baseline

TABLE 10
LEAST SQUARES REGRESSION USING MAIN EFFECTS AND INTERACTIONS
(only interactions that proved to be significant at the 0.05 level are listed)

Variable	Beta Weight	Standard Error	T-stat	Signif
Culture × Animals	−.226	.084	−2.696	.007
Culture × Speed	−.198	.038	−5.218	<.001
Culture × Quick Action	.198	.046	4.277	<.001
Culture × Overtaking	.161	.051	3.172	.002
Culture × Country of Slide	−.143	.033	−4.370	<.001
Sex × Older Drivers	.140	.027	5.255	<.001
Culture × Professional Drivers	−.098	.027	−3.681	<.001
Culture × Limited Access	−.094	.026	−3.634	<.001
Older Driver × Quick Action	.084	.041	2.060	.040
Sex × Culture	−.077	.030	−2.544	.011
Sex × Country of Slide	−.063	.031	−2.077	.038
Culture	.528	.098	5.367	<.001
Uncertainty	−.223	.026	−8.552	<.001
Quick Action	−.211	.032	−6.508	<.001
Lane Intrusion	−.196	.025	−7.830	<.001
Complexity	.183	.027	6.803	<.001
Animals	.169	.028	5.961	<.001
Following Distance	−.162	.022	−7.515	<.001
Professional Drivers	.156	.028	5.678	<.001
Preview Distance	−.149	.026	−5.777	<.001
Environment	−.142	.027	−5.328	<.001
Intersection	−.126	.024	−5.210	<.001
Younger Drivers	−.115	.021	−5.391	<.001
Weather	−.114	.024	−4.781	<.001
Pedestrians or Bicyclists	.111	.023	4.826	<.001
Older Drivers	−.099	.045	−2.214	.027
Road Surface Friction	−.097	.022	−4.439	<.001
Tunnel or Bridge	.095	.019	4.909	<.001
Limited Access	−.083	.027	−3.057	.002
Level Roadway	−.080	.021	−3.798	<.001
Straight Roadway	−.055	.024	−2.343	.019
Road Delineation	−.054	.032	−1.674	.094
Overtaking	−.043	.028	−1.504	.133
Country of Slide	.043	.034	1.247	.213
Traffic Density	−.037	.021	−1.708	.088
Stopped Vehicle in the Lane	−.024	.020	−1.188	.235
Speed	.022	.030	.721	.471
Sex	.021	.032	.661	.509
Ambient Illumination	−.002	.024	−.092	.926

$r^2 = .537$

TABLE 11
INTERPRETATION OF THE SIGNIFICANT INTERACTIONS

Interactions with Culture	Culture	
	U.S.A.	Spain
Animals	Decreased risk for the presence of animals	Either no effect or increased risk for the presence of animals
Speed	No effect of speed	Increased risk for increased speed
Quick Action	Increased risk for potential for quick action	No effect
Overtaking	No effect for overtaking	Decreased risk for overtaking
Country of Slide	No effect for country of slide	Decreased risk for U.S. slides
Limited Access	Decreased risk for limited access roadway (shallower slope than for Spain)	Decreased risk for limited access roadway (steeper slope than for the U.S.A.)
Professional Drivers	Increased risk for professional drivers (steeper slope than for Spain)	Increased risk for professional drivers (shallower slope than for the U.S.A.)

Interaction with Sex	Sex	
	Male	Female
Culture	Increased risk for Spanish subjects (steeper slope than for females)	Increased risk for Spanish subjects (shallower slope than for males)
Older Drivers	Decreased risk for older drivers	No effect or increased risk for older drivers
Country of Slide	No effect for country of slide	No effect or decreased risk for U.S. slides

Interaction with Older Driver	Subject Group	
	Middle-Aged	Older
Quick Action	Increased risk for potential for a quick action (steeper slope than for older subjects)	Increased risk for potential for a quick action (shallower slope than for middle-aged subjects)

DISCUSSION

The main findings of this study are as follows:

(1) Spanish drivers gave higher risk-ratings to the same slides of traffic scenes than did U.S. drivers, with the effect being stronger for males than for females.

(2) Younger drivers in both countries tended to report lower risk than did middle-age drivers. This result supports the hypothesis that lower perceived risk might be one factor in young drivers's overrepresentation in road accidents (Williams, 1985). However, it is apparent (see Table 4) that the age effect was not uniform for all combinations of culture and sex of the subject: While the effect was strong for Spanish females and U.S. males, it was weak for Spanish males and absent for U.S. females. (This study did not formally test for higher than first-order interactions.) Consequently, this study provides expansion and qualification of previous findings on young subjects' lower level of perceived risk (e.g., Cairney, 1982; Finn and Bragg, 1986; Matthews and Moran, 1986).

(3) While professional drivers tended to report higher risk than did non-professional drivers of the same age, this effect was primarily due to U.S. drivers.

(4) Culture, subject group, and sex accounted for 34.4% of the variance in risk-ratings.

(5) The main effects of the characteristics of the traffic scenes accounted for an additional 15.2% of the variance.

(6) The most powerful factors (that did not figure in the significant first-order interactions) were uncertainty in the traffic situation, intrusion in the lane of travel, complexity of the traffic situation, following distance, preview distance, and environment (day/night). All of these effects were in the expected directions, with the exception of complexity. (When bivariate, as opposed to multivariate, relationships were examined, the effect of complexity was in the expected direction.)

(7) The interactions of slide characteristics with culture, group, and age accounted for an additional 4.1% of the variance.

(8) Among the interactions with the characteristics of the slides, the following two are of potential practical interest. First, while the U.S. subjects rated potential need for quick action as resulting in greater risk, the Spanish subjects were unaffected by this parameter. Second, while the Spanish drivers rated higher speeds as more risky, the risk estimates of the U.S. drivers were unaffected by speed.

(9) A total of 53.7% of the variance in risk-ratings can be accounted for by the studied independent variables and their first-order interactions.

(10) The current fatality rate per 100,000 vehicle kilometers in Spain is about twice the rate in the U.S. For example, in 1984 the rate in Spain was 5.1 (Direccion General de Trafico, 1985) and 2.5 in the U.S. (National Safety Council, 1985). (The rates are for rural roads only, since the urban [and total] rates for Spain were unavailable.) The present findings suggest that the difference in accident rates is unlikely to be the result of a decreased level of perceived risk in Spain. (The obtained main effect was in the other direction.) However, the perceived risk was inferred from the reported risk, and it is possible that subjects in the two countries

utilized the scale differently, without any differences in perceived risk. On the other hand, the obtained interactions are not subject to this potential criticism. The differential effect of potential need for quick action on the reported risk in the two countries is especially intriguing and it may contribute to the differential accident rates (along with factors that were not evaluated in the present study, such as differences in roadways, vehicles, seat-belt use, etc.).

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