DRIVER RISK-TAKING IN SPAIN AND THE U.S.A.

Jose Soler, Ph.D.

The University of Valencia
Faculty of Psychology
Department of General Psychology, Methodology, and Psychobiology
Valencia, Spain

Michael Sivak, Ph.D.

The University of Michigan
Transportation Research Institute
Ann Arbor, Michigan 48109, U.S.A.

Report No. UMTRI-87-34
August 1987

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTRI-87-34		

4. Title and Subtitle	5. Report Date
DRIVER RISK-TAKING IN SPAIN AND THE U.S.A.	August 1987
	6. Performing Organization Code: 022567
	8. Performing Organization Report No.: UMTRI-87-34
7. Author(s): Jose Soler and Michael Sivak	
9. Performing Organization Name and Address: The University of Valencia, Faculty of Psychology, Department of General Psychology, Methodology, and Psychobiology, Valencia, Spain, and The University of Michigan Transportation Research Institute, Ann Arbor, Michigan, 48109, U.S.A.	10. Work Unit No.
	11. Contract or Grant No.: CCA-8411/001
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address: U.S.-Spain Joint Committee for Scientific and Technological Cooperation, Paseo del Prado, 28-5.ª Planta, 28014 Madrid, Spain	14. Sponsoring Agency Code
15. Supplementary Notes	

16. Abstract

This study investigated differences in driver risk-taking between Spanish and U.S. subjects. The task consisted of performing a simulated intersection crossing on a video display. Subjects were shown an intersection with moving traffic on a horizontal road, and they were asked to attempt (under time pressure) a fixed number of crossings with a car moving vertically. The subjects in both countries included younger, middle-aged, and older persons of both sexes.

The following are the main findings: (1) There were no main effects of culture on any of the dependent variables. (2) Target risk-level of performance, measured by probability of successful crossing, was generally not affected by culture, age, and sex. (3) Probability of attempted crossing was greater for males and younger subjects than for females and older subjects. (4) Similarly, safety margins during attempted crossings were smaller for males and younger subjects than for females and older subjects.

The present results suggest that all subjects have the same target risk level of performance. To attain this risk level of performance, males and younger subjects (because of their presumed superior psychomotor skills and/or greater experience with video tasks) attempted to cross more gaps (and, consequently, smaller gaps), with resulting smaller safety margins.

17. Key Words	18. Distribution Statement
Driving, risk-taking, decision-making, psychology, cross-cultural comparison, Spain, U.S.A., driver age, driver sex	Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	12	

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to Hector Monterde i Bort, the designer of the test used in this study; to Manuel Juan Martinez, who did the computer programming; and to the Valencian firm General Asde S.A., which kindly assisted in the development of the test.

Appreciation is extended to John H. Chambers, A. Regula Herzog, Paul L. Olson, and Ulrich Tränkle for their assistance and advice in conducting this research.

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INTRODUCTION

This is the fourth and last 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, 1986a) involved an analysis of factors associated with traffic accidents in the two countries. The second study (Sivak and Soler, 1986b) investigated perception of risk in slide-projected photographs of traffic scenes. The third study (Sivak and Soler, 1987) dealt with driver self-assessment.

The present study focused on driver risk-taking in a simulated intersection crossing. The primary objective was to investigate differences between risk-taking of Spanish and U.S. drivers. The secondary objective was to study age-related differences in driver risk-taking.

METHOD

Task

The task in this study was to perform simulated intersection crossings on a video display (see Figure 1). Subjects were shown an intersection with moving traffic on the horizontal (main) road. This traffic contained a variety of gap sizes. A stationary car was positioned at a stop sign on the vertical (secondary) road. By pressing the space bar on the computer keyboard, the stationary car began to move upwards, crossing the horizontal road. If the car successfully crossed the road (i.e., without hitting any of the moving cars on the horizontal road), another stationary car appeared at the stop sign. On the other hand, if the car hit another vehicle while attempting to cross the road, the scene "froze" for 5 seconds with a loud beep. After this delay another car appeared at the stop sign.

The vehicles on the horizontal road moved at a constant speed of approximately 24 mm/sec. After subjects pressed the space bar on the computer keyboard, the subjects' cars accelerated in such a fashion that it took them about 1 sec to clear the intersection.

Equipment

IBM-PC/XT microcomputers were used in both Spain and the U.S.A. To assure the same speed of the moving elements in the display, the clock speeds and the microprocessors were the same in both countries (i.e., 4.77 MHz and 8088, respectively). Similarly, to assure compatibility in the color graphics of the display, IBM color monitors with CGA graphics cards were used in both countries.

Subjects

A total of 120 subjects participated in this study. Sixty were tested in Spain and sixty 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 three age groups: 19–21 year olds, 35–45 year olds, and 65–75 year olds. The actual ages of subjects in each group are shown in Table 1. 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 tested without reimbursement, came primarily from Valencia, a city with a population of approximately 800,000.

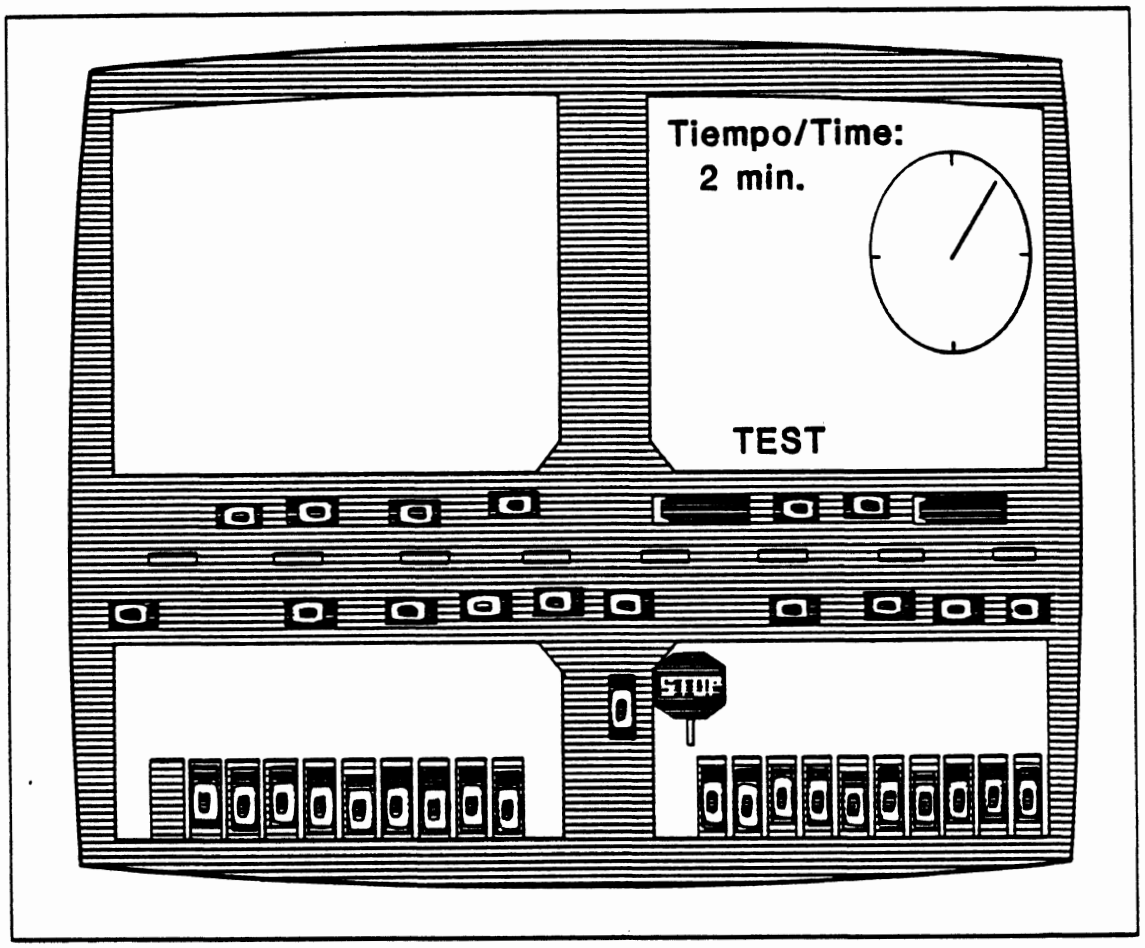

Figure 1. Schematic of the experimental display.

TABLE 1
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	20.5
	U.S.A.	Males	10	19	21	20.5
		Females	10	19	21	20.3
Middle-Aged	Spain	Males	10	38	45	41.5
		Females	10	35	45	41.0
	U.S.A.	Males	10	36	45	40.6
		Females	10	35	45	40.0
Older	Spain	Males	10	65	75	71.9
		Females	10	65	74	66.7
	U.S.A.	Males	10	66	74	70.2
		Females	10	65	74	70.2

Procedure

At the beginning of the session, subjects were given twelve practice trials. For the actual testing, subjects were presented with twenty cars on the bottom of the display (see Figure 1). Subjects were instructed to attempt to cross the intersection with as many cars as possible (from the twenty cars available). Furthermore, subjects were instructed that they should avoid crashes, and that they had two minutes within which to make all the crossings. (A clock was visible in the upper right section of the display [see Figure 1]). The total session (with instructions and practice trials) lasted about five minutes per subject.

Dependent Variables

The computer stored the following information for each subject's performance: number of opportunities (gaps physically large enough to cross, given the speed of the horizontal traffic and the acceleration of the subject's car—this measure is affected by the number of crashes, since each crash resulted in a "frozen" scene for 5 sec), number of successful crossings, number of crashes, and mean of the minimum clearance for all attempted crossings (see below for details).

The following three variables were selected for the analysis:

Probability of attempt—attempts (successful crossings plus crashes) divided by opportunities. With the assumption that probability of attempt was inversely related to average gap size accepted, this variable was an indirect measure of attempted gap sizes. (A direct measure of gap size per attempt was not available.)

Probability of success—successful crossings divided by attempts. This variable measured risk-level of performance.

Minimum clearance—mean for all attempted crossings of the minimum separation between the subject's car and the four horizontally moving vehicles forming the gap in traffic; in pixels. This variable evaluated safety margins of performance.

RESULTS

Only twelve of the 120 subjects (six in Spain and six in the U.S.A.) made the maximum possible of 20 attempts within the two minute limit. Furthermore, only two of these subjects (both from the U.S.A.) successfully crossed in all 20 attempts.

Analyses of variance were performed on all three dependent variables—probability of attempt, probability of success, and minimum clearance. The independent variables in these analyses were culture, age group, and sex.

Probability of Attempt

The mean probabilities of attempt by culture, age, and sex are shown in Table 2. The difference between the probability of attempt in Spain and in the U.S.A. failed to reach statistical significance, $F(1,108) = 2.27$, $p = .13$. On the other hand, there was a statistically significant effect of age, with younger subjects attempting to cross proportionally most often, followed by middle-aged subjects, and older subjects, $F(2,108) = 6.24$, $p < .01$. Similarly, there was a statistically significant effect of sex, with males attempting to cross proportionally more often than females, $F(1,108) = 6.23$, $p = .01$.

TABLE 2
Mean probability of attempt by culture, age, and sex.

Independent Variable	Level	Mean Probability of Attempt
Culture	Spain	.58
	U.S.A.	.64
Age	Younger	.69
	Middle-aged	.62
	Older	.53
Sex	Males	.66
	Females	.56

Only one interaction—culture × sex—reached statistical significance. Specifically, U.S. males attempted to cross proportionally more often ($M = .75$) than U.S. females ($M = .53$), while no difference was evident between Spanish males ($M = .57$) and Spanish females ($M = .60$).

Probability of Success

The mean probabilities of success by culture, age, and sex are shown in Table 3. None of the main effects reached statistical significance.

TABLE 3
Mean probability of success by culture, age, and sex.

Independent Variable	Level	Mean Probability of Success
Culture	Spain	.81
	U.S.A.	.83
Age	Younger	.80
	Middle-aged	.84
	Older	.83
Sex	Males	.84
	Females	.81

Only one interaction was statistically significant—culture × age, $F(2,108) = 3.14$, $p < .05$. (The mean probabilities of success in Spain, from younger through middle-aged to older subjects were .79, .87, and .78, while in the U.S.A. they were .81, .81, .87.)

Minimum Clearance

The mean minimum clearances by culture, age, and sex are shown in Table 4. The difference between Spanish and U.S. subjects was statistically not significant, $F(1,108) < 1$. On the other hand, there was a significant effect of age, with younger subjects having the smallest minimum clearance, followed by the middle-aged subjects, and older subjects, $F(2,108) = 3.14$, $p < .05$ Similarly, minimum clearance was smaller for males than for females, $F(1,108) = 8.60$, $p < .01$. None of the interactions were statistically significant.

TABLE 4
Mean minimum clearance by culture, age, and sex.

Independent Variable	Level	Mean Minimum Clearance (in pixels)
Culture	Spain	10.0
	U.S.A.	9.9
Age	Younger	9.0
	Middle-aged	9.8
	Older	11.0
Sex	Males	9.0
	Females	10.9

DISCUSSION

Effects of Culture

The main aim of this study was to investigate whether there are any cultural differences in performance on a task simulating driver risk-taking behavior at an intersection. The results indicate that there were no main effects of culture on any of the three dependent variables (probability of attempt, probability of success, and minimum clearance). However, culture featured in two statistically significant interactions. One such interaction was culture × sex for probability of attempt, with a higher probability of attempt for males than females in the U.S.A. but not in Spain. The other significant interaction involving culture was culture × age for probability of success. Specifically, the highest probability of success was reached in the U.S.A. by middle-aged subjects, while in Spain by older subjects.

Effects of Age

Potential age effects constituted the second main topic of this study. The results indicate that younger subjects had the highest probability of attempted crossings, followed by middle-aged and older subjects. On the other hand, there was no main effect of age on probability of success, although culture × age interaction was significant (see above).

Age had a significant effect on the safety margins during the attempted crossings: Minimum clearance was smallest for younger subjects, followed by middle-aged subjects, and older subjects.

Effects of Sex

There was no main effect of sex on probability of success or probability of attempt (although culture × sex interaction was significant for probability of attempt [see above]). However, males had significantly smaller safety margins (as measured by the minimum clearance during attempted crossings) than did females.

Probability of Attempt vs. Probability of Success vs. Minimum Clearance

The present data indicate that subjects tended to have the same target risk-level of performance. This conclusion is based on the absence of main effects of culture, age, and sex on probability of success. (However, the interaction of culture × age was statistically significant.)

To achieve this common target risk-level of performance, both male and younger subjects attempted crossings proportionally more often than did female and older subjects. The analysis of minimum clearance, measuring safety margins during attempts, suggests that the additional attempts for both males and younger subjects involved smaller gaps. This conjecture is based on the fact that the minimum clearance for male and younger subjects were shorter than for female and older subjects.

Potential Implications

The present data suggest that all subjects, regardless of their culture, age, and sex tended to have the same target risk-level of performance (as measured by the probability of successful crossings). If males and younger subjects were to attempt to cross gaps of the same difficulty (size) as females and older subjects, the presumed superior psychomotor skills and/or greater experience with video tasks of males and younger subjects would have led to higher probabilities of success for these subject groups than the target risk-level of performance. Consequently, males and younger subjects accepted smaller safety margins by attempting to cross smaller gaps (a conjecture), with resulting higher probability of attempt and smaller safety margins (both experimentally obtained).

Frequencies of Successes, Crashes, and Attempts

Probability of attempt was significantly correlated with both *frequency* of successes, $r(118) = .84$, $p < .001$, and *frequency* of attempts, $r(118) = .96$, $p < .001$. Similarly, *probability* of success was significantly correlated with *frequency* of crashes, $r(118) = -.82$, $p < .001$. Consequently, it is not surprising that the results of analyses of variance for *frequencies* of successes and attempts (not reported here in detail) were the same as for *probability* of attempt (i.e., significant effects of age, sex, and culture × sex interaction). Similarly, the results of the analysis of variance for *frequency* of crashes (again not reported here in detail) were essentially the same as the results for *probability* of success. Specifically, there were no significant main effects or interactions. (Culture × age interaction was significant for *probability* of success, but not for *frequency* of crashes.) Consequently, the selection of the dependent variables was guided by theoretical considerations concerning the underlying model of human risk-taking.

Concluding Comments

The experimental task was designed to simulate driver risk-taking behavior at an intersection. However, the degree to which this task was indeed perceived by subjects as analogous to the real-world situation is unknown. Consequently, determination of the applicability of the present results to driving must await a validation of the present task in relation to actual intersection-crossing behavior.

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