DOCUMENT RESUME

ED 126 235 CE 005 995

AUTHOR Soliday, Stanley M.; Allen, John A., Jr.
TITLE Age and Sex Factors in the Control of Automobiles.
INSTITUTION North Carolina Univ., Chapel Hill. Highway Safety Research Center.
SPONS AGENCY Governor's Highway Safety Program Office, Raleigh, N.C.
PUB DATE Feb 72
NOTE 21p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Age Differences; Age Groups; *Comparative Analysis; *Females; *Males; *Motor Vehicles; *Performance Factors; Sex Differences; Skill Analysis
IDENTIFIERS *Driver Performance

ABSTRACT

The study investigated age and sex in the control of an automobile under normal driving conditions. Its major purpose was to gather baseline data for a driver license, road testing program. Forty volunteer subjects (10 men and 10 women over 30, 10 men and 10 women under 30) drove a specially instrumented car over an interstate highway course and a heavily traveled urban course. The following variables were measured: total trip time, miles traveled, speed changes, lane changes, fine steering reversals, accelerator reversals, brake applications, and average speed. Several differences were found between vehicle control patterns of the men and women. Several smaller differences appeared between age groups. Finally, a comparison of interstate data with that of a previous study revealed consistency between groups, but a significant difference with respect to lane changes. As expected, the type of roadway had a profound effect on the control patterns of all subjects. (Author/BP)

AGE AND SEX FACTORS
IN THE
CONTROL OF AUTOMOBILES

by

Stanley M. Soliday
North Carolina State University
Raleigh, North Carolina

and

John A. Allen, Jr.
University of North Carolina
Highway Safety Research Center
Chapel Hill, North Carolina

February 1972

The present study was conducted as part of a larger project, entitled Driver License Road Testing (DL-69-001 (002)), contracted with the North Carolina Department of Motor Vehicles and sponsored by the North Carolina Governor's Highway Safety Office.

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGMENTS

Appreciation is extended to Mr. Henry Lowery, Driver Improvement Coordinator for the North Carolina Driver License Division. Mr. Lowery contacted the subjects, arranged for them to drive at specified times, and helped obtain biographical data from them.

The authors also wish to extend special thanks to Mr. Dan McIntyre, a Senior Driver License Examiner for North Carolina. Mr. McIntyre served expertly as the experimenter, and provided valuable assistance in laying out the test courses.

Traffic counts were gathered by Mr. Jack Daye, a Senior Driver License Examiner, and his help was invaluable.

ABSTRACT

Forty volunteer subjects drove a specially instrumented car over an interstate highway course and over a heavily traveled urban course. Ten subjects were men over 30 years of age, ten were women over 30, ten were men under 30, and ten were women under 30. Several differences were found between vehicle control patterns of the men and women. Several smaller differences appeared between age groups. Finally, a comparison of interstate data with that of a previous study (Soliday and Allen, 1972) revealed consistency between groups, apart from a significant difference with respect to lane changes. As expected, the type of roadway course had a profound effect on the control patterns of all subjects.

INTRODUCTION

A previous study by Soliday and Allen (1972) supported the notion that the type of highway a person drives is an important variable in determining how he controls his automobile. An instrumented car was used to compare driving behavior on an interstate highway course with that on a rural two-lane course. In brief, in terms of numbers of speed changes, drives on the interstate course were found to be smoother than those on the rural course. Also, course tracking efficiency, as measured by steering wheel reversals, was better on the interstate course, i.e., drivers made fewer steering control movements on the interstate course. Subjects were young women with generally good driving records and might be regarded as an "average" group of drivers.

In an effort to extend these findings, the present study investigated age and sex in the control of an automobile under normal ("everyday") driving conditions. The major purpose of the study was to gather baseline data for a driver license road-testing program. A secondary aim was to determine whether results obtained in one test vehicle with a given experimenter (driver license examiner) are *in any way* consistent with those obtained in another test car with a different experimenter

METHOD

Subjects

Forty volunteer drivers served as subjects. All subjects were employes of the N. C. Department of Motor Vehicles in Raleigh. They were formed into four groups on the basis of age and sex. Table 1 details the composition of the groups. As can be seen, the women were slightly younger than the men on the average and had driven for fewer years. Still, the groups of men and women over 30 formed distinctly different age groups from the men and women under 30. Mann-Whitney U-tests revealed no significant differences between the four groups with respect to numbers of traffic accidents and violations.

Table 1. Subject Groups

Age and Experience	Men Over 30 (N=10)	Women Over 30 (N=10)	Men Under 30 (N=10)	Women Under 30 (N=10)
Mean Age	47.5	41.3	24.1	20.5
Age Range	35-56	32-53	22-25	18-26
Mean Years Driving	28.6	19.9	8.3	4.8
Range of Years Driving	20-40	12-36	6-10	3-10

The Test Car

An instrumented car owned by the State of North Carolina was used as the test vehicle. The following variables were measured on digital counters and recorded as data during test runs: total trip time; running time (time the car was actually moving), miles traveled; speed changes (each two and one-half miles per hour speed change counted), lane changes or coarse steering wheel reversals (each steering wheel movement of 12 degrees or more followed by a reversal of the movement); fine steering wheel reversals (each steering wheel movement of two degrees or more followed by a reversal of the movement), accelerator reversals (each travel of pedal one eighth inch more up or down and then reversed, and brake applications (each depression of pedal strong enough to turn on the brake light). Average speed during a test run was calculated by multiplying the number of miles traveled by 60 and then dividing the resulting number by the time in minutes that the car was moving.

Test Courses

Two test courses were laid out, an "interstate" and a "traffic" course. The "interstate" course was the same one used in the Soliday and Allen (1972) study. In brief, it was laid out on the U.S. 1 Raleigh by pass, and extended from the intersection of U.S. 1 with U.S. 64 to the Cary exit about 10 miles away, and back from the Cary exit to the U.S. 64 intersection, for a total length of 20.1 miles The road was a four lane highway divided by a grass-covered median strip, with a few long, easy curves and slight elevations. There was a total of 12 entrance and exit ramps.

The second course was a heavy traffic route laid out over some of the busier streets in Raleigh. It began on the Downtown Boulevard at the Farmer's Market sign near the U.S. 1 intersection, ran South to Hillsborough Street, then west on Hillsborough to N.C. State University, turned around, ran east on Hillsborough to the State Capitol, then south at the Capitol on Salisbury Street to Morgan Street, then east on Morgan to New Bern Avenue, and east (still) on New Bern to the Department of Motor Vehicles Building. Course length was 8.7 miles. Traffic was almost uniformly heavy along the entire route.

Procedures

After a subject filled out biographical data forms, he was briefed about the nature of the experiment by the experimenter, a N. C. Senior Driver License Examiner. The courses were described, and the subject was told to drive as he normally would, obeying all traffic laws. In addition, subjects were asked to report any hazardous situations encountered as they drove. Hazards were described by the experimenter as any situation that seemed potentially dangerous, from a "tail-gater" to a "too-narrow bridge." The data were obtained as part of a broad investigation of how drivers perceive hazards.

After instructions, a subject drove east on New Bern Avenue (U.S. 64) to its intersection with U.S. 1, entered U.S. 1 and drove to the Cary exit, turned around, and drove back to the U.S. 1 intersection. The counters were turned on when the subject first entered U.S. 1 and remained on until he turned around at the Cary exit. They were turned off during the period of turning around, and then turned on again after the subject was back on U.S. 1 and stayed on until the end of the course, i.e., at the U.S. 64 intersection. At that point they were turned off and the data were recorded.

After completing the "interstate" course, the subject drove U.S. 1 to its intersection with the Downtown Boulevard. At the intersection, the subject drove south on the Boulevard to the Farmer's Market sign, at which point the counters were turned on to record data for the "traffic" course. The subject then drove the entire traffic course without stopping (except where mandatory by traffic regulations) to its end at the Department of Motor Vehicles Building, at which point the counters were turned off and the traffic data recorded.

Subjects were tested at 8:00 am, 9:45 am, 2:00 pm, or 3:15 pm, Monday through Friday. Assignments of times and days were made at random before the experiment began. All subjects drove both courses, and in the same direction.

Traffic counts were taken at all test hours, Monday through Friday, by an independent observer who drove the courses in the opposite direction to that driven by the subjects. The observer counted all vehicles that passed him in the opposite direction so that counts would reflect traffic in the subject's lane.

RESULTS

The courses were almost always dry during testing, and visibility was always good. The interstate course took an average of 21.5 minutes to drive and the traffic course took an average of 20.4 minutes. Total test time was approximately one hour per subject, which included instruction time, time to drive to the courses and 41.9 minutes to drive the courses. Approximately equal numbers of subjects from the four groups drove at the four testing hours and the days of the week.

Table 2 presents average traffic counts to give the reader an idea of traffic during the tests. Counts reflect numbers of cars in the subject's lane per mile of travel, and are given for each hour of testing and for each day of the week.

Table 2. Traffic Counts: Vehicles/Mile Met in Opposite Lane

Hour and Day	Interstate Course	Traffic Course
8:00 A.M.	32	56
9:45 A.M.	23	53
2:00 P.M.	25	59
3:15 P.M.	26	66
Monday	26	62
Tuesday	26	55
Wednesday	25	59
Thursday	26	55
Friday	31	61

(Note that the counts were heavier on the traffic course at all hours and days, and that counts were fairly consistent by hour and by day for both courses. Also, slightly higher than normal counts appear at 8:00 and on Friday on the interstate course, and at 3:15 on the traffic course).

Data Handling

Total trip time, total driving time, number of miles driven, speed changes, lane changes, fine steering reversals, accelerator reversals, and brake applications were recorded for each subject for each of the two courses. Of these measurements, speed change, lane change, fine steering reversals, accelerator reversals, and brake applications were used as dependent variables. Average speed calculated from total running time and miles driven provided another dependent variable.

For each mile traveled, the average occurrence of a given dependent variable was calculated for each subject. The total count of a given dependent variable for each subject on a given course was divided by the number of miles driven to provide an average count per mile per subject per course. For example, if a subject made 450 fine steering reversals on the interstate course, 450 was divided by 20.1, the length of the course, to yield a count of 22.4 reversals per mile for that subject on that course. Analyses of variance were performed on each dependent variable, using a mixed design of two between-subjects sources of variance (age and sex) and one within-subjects source (type of highway) (Winer, 1962).

Speed Changes

Table 3 lists the descriptive speed change data and Table 4 presents the analysis of variance summary. Some examples of interpreting this and succeeding tables are as follows: When men over 30 (N = 10) drove over the interstate course, they made an average of 5.0 speed changes per mile (column headed M, for mean), with a standard deviation of 1.0 speed change per mile (column headed SD, for standard deviation). The subject who made the fewest of all in that group averaged 3.3 changes per mile (column headed R, for range), while the subject who made the most averaged 6.7 per mile. As another example, when women (N = 20) drove in traffic, they averaged 84.0 speed changes per mile, with a standard deviation of 11.2 and extreme scores of 64.3 and 103.8.

Table 3. Speed Change

Groups	Interstate Course			Traffic Course		
	M	SD	R	M	SD	R
Men over 30	5.0	1.0	3.3-6.7	77.9	9.2	58.4-88.9
Women over 30	6.7	1.9	3.7-9.4	81.6	9.1	64.3-97.9
Men under 30	5.0	1.2	3.6-7.8	72.8	14.8	34.6-88.7
Women under 30	5.8	.9	4.5-7.2	86.3	12.5	66.6-103.8
Men (N = 20)	5.0	1.5	3.3-7.4	75.4	12.6	34.6-88.9
Women (N = 20)	6.3	1.6	3.7-9.4	84.0	11.2	64.3-103.8
Over 30 (N = 20)	5.9	1.8	3.3-9.4	79.8	9.3	58.4-97.9
Under 30 (N = 20)	5.4	1.1	3.6-7.4	79.6	5.8	34.6-103.8

Table 4. Summary Analysis of Variance of Speed Change Data

Source	SS	df	MS	F
Between Subjects	3536.1	39		
Sex	480.7	1	480.7	5.9*
Age	3.0	1	3.0	
Sex x Age	98.7	1	98.7	1.2
Sub. within groups	2953.7	36	82.1	
Within Subjects	112635.4	40		
Highway	109660.7	1	109660.7	1540.2*
Sex x Highway	271.5	1	271.5	3.8*
Age x Highway	.1	1	0	
Sex x Age x Highway	139.8	1	139.8	2.0
Highway x sub. within groups	2563.3	36	71.2	

*p<.05

**p<.01

An analysis of variance of speed changes revealed that the main effect for sex was significant at the five percent level, while the main effect for type of highway was significant beyond the one percent level.

Table 3 shows that the women made an average of 45.2 speed changes per mile when both courses are considered. Men average 40.2 per mile. The difference is about 11.7 percent (45.2 ÷ 40.2 x 100).

Sex and highway also interacted significantly, viz., women made 12.6 percent more speed changes per mile than men on the interstate course (6.3 vs 5.0), and 11.1 percent more on the traffic course (84.0 vs 75.4).

As one might expect, performance on the two courses differed greatly. The main effect for the type of highway was highly significant. An average driver made 79.7 speed changes per mile when driving in traffic (77.9 for men over 30, plus 81.6 for women over 30, plus 72.8 for men under 30, plus 86.3 for women under 30 = 318.6 ÷ 4 = 79.7). However, the average driver made only 5.7 speed changes per mile on the interstate course.

Lane Change

Lane change descriptive data and the analysis of variance summary are presented in Tables 5 and 6 respectively. Both the sex and highway type main effects were significant beyond the one percent level. The interactions, sex by highway and age by highway, were also significant beyond the one percent level.

With respect to the sex main effect, it should be noted that women made 14.0 lane changes per mile (average over both courses) while men made 10.7 per mile. In terms of percentage, the women made 30.8 percent more. This difference did not exist to the same degree on both types of course An examination of the significant sex by highway revealed that women made more lane changes than men on the interstate course. 4.7 lane changes per mile vs 3.1 per mile, respectively (a difference of 51.6 percent). Also, on the traffic course, women made 23.2 lane changes per mile and men 18.2 per mile, a difference of 27.4 percent.

Age (irrespective of sex) and highway interacted significantly, reflecting the fact that the 20 drivers over 30 years of age made 5.3 percent more lane changes per mile than the 20 drivers under 30 on the interstate course (4.0 vs 3.8), whereas they made only 2.9 percent more per mile on the traffic course. Thus, the data indicate that the over-30 group may have been affected more by the type of highway driven than the under-30 group.

The significant highway type main effect reflects the fact that subjects made substantially more lane changes per mile on the traffic course than on the interstate course (20.7 vs 3.9).

Table 5. Lane Change

Groups	Interstate Course			Traffic Course		
	M	SD	R	M	SD	R
Men over 30	3.2	.3	2.3-3.9	18.9	4.0	12.0-25.1
Women over 30	4.7	1.3	2.7-7.5	23.1	4.0	17.8-31.7
Men under 30	3.0	.02	2.4-4.3	17.5	3.9	14.0-27.0
Women under 30	4.6	1.1	2.9-6.9	23.3	3.0	18.0-27.0
Men	3.1	.8	2.3-4.3	18.2	4.0	12.0-27.0
Women	4.7	1.2	2.7-7.5	23.2	3.6	17.8-31.7
Over 30	4.0	1.4	2.3-7.5	21.0	4.6	12.0-31.7
Under 30	3.8	1.3	2.4-6.9	20.4	4.6	14.0-27.0

Table 6. Summary Analysis of Variance of Lane Change Data

Source	SS	df	MS	F
Between Subjects	635.0	39		
Sex	218.8	1	218.8	19.2*
Age	2.6	1	2.6	
Sex x Age	3.9	1	3.9	
Sub. within groups	409.7	36	11.4	
Within Subjects	5967.8	40		
Highway	5653.2	1	5653.2	99.2**
Sex x Highway	59.0	1	59.0	10.4**
Age x Highway	46.1	1	46.1	8.1**
Sex x Age x Highway	3.1	1	3.1	
Highway x sub. within groups	206.4	36	5.7	

*$p < .05$

**$p < .01$

Fine Steering Reversals

Fine steering reversal statistics and the analysis of variance summary are listed in Tables 7 and 8 below. The analysis revealed two significant main effects, sex and type of highway, and one significant interaction, sex by age.

The significant sex main effect reflected the fact that women made 77.4 fine steering reversals per mile compared to 62.4 per mile for men, a difference of 12.4 percent.

With respect to age and sex interaction, men over 30 made 68.1 reversals per mile while men under 30 made 56.7 per mile, i.e., the older group made 20.1 percent more. However, women over 30 made 72.6 per mile and women under 30 made 82.2 per mile, a difference of 13.2 percent.

Drivers made over twice as many fine steering reversals per mile on the traffie course than on the interstate course. Actual figures were 96.6 per mile for the traffic course and 43.3 per mile for the interstate course.

Accelerator Reversals

Descriptive statistics and summary analysis of variance for accelerator reversals are given in Tables 9 and 10. One main effect, type of highway, was significant. No interactions were significant. With regard to the highway variable, drivers, as one would expect, changed speed more frequently on the traffic course than on the interstate course.

Table 7. Fine Steering Reversals

Groups	Interstate Course			Traffic Course		
	M	SD	R	M	SD	R
Men over 30	38.9	10.9	22.3-54.8	97.2	23.2	60.5-128.7
Women over 30	46.5	6.5	34.2-56.3	98.6	14.0	79.8-131.7
Men under 30	33.4	8.0	20.5-47.9	80.0	17.4	53.4-109.0
Women under 30	54.0	11.1	32.3-70.3	110.3	23.0	76.9-149.8
Men	36.2	9.9	20.5-54.8	88.6	7.1	53.4-128.7
Women	50.3	9.9	34.2-70.3	104.5	6.4	76.9-149.8
Over 30	42.7	9.7	22.3-56.3	97.9	6.1	60.5-131.7
Under 30	43.7	4.5	20.5-70.3	95.2	25.7	53.4-149.8

Table 8. Summary Analysis of Variance Fine Steering Reversals

Source	SS	df	MS	F
Between Subjects	22541.8	39		
Sex	4498.5	1	4498.5	22.6**
Age	19.2	1	14.2	
Sex x Age	2191.5	1	2191.5	5.0*
Sub. within group	15837.6	36	439.9	
Within Subjects	60925.7	40		
Highway	56748.0	1	56748.0	547.2**
Sex x Highway	112.5	1	112.5	1.1
Age x Highway	166.3	1	166.3	1.6
Sex x Age x Highway	217.3	1	217.3	2.1
Highway x sub. within groups	3682.6	36	102.3	

*$p < .05$

**$p < .01$

Table 9. Accelerator Reversals

Groups	Interstate Course			Traffic Course		
	M	SD	R	M	SD	R
Men over 30	2.7	.3	1.4-4.3	9.8	2.0	7.8-14.4
Women over 30	2.8	2.2	1.7-4.0	9.8	1.1	7.8-11.4
Men under 30	3.1	.6	2.1-4.1	9.7	1.9	7.5-1.0
Women under 30	3.3	1.1	1.9-5.4	10.6	1.8	7.7-14.0
Men	2.9	.8	1.4-4.3	9.8	2.0	7.5-14.4
Women	3.1	.9	1.7-5.4	10.2	1.6	7.7-14.0
Over 30	2.8	.8	1.4-4.3	9.8	1.6	7.8-14.4
Under 30	3.2	.9	1.9-5.4	10.2	1.9	7.5-14.0

Table 10. Summary Analysis of Variance of Accelerator Reversals

Source	SS	df	MS	F
Between Subjects	120.9	39		
Sex	1.9	1	1.9	
Age	3.5	1	3.5	1.1
Sex x Age	1.2	1	1.2	
Sub. within groups	114.3	36	3.2	
Within Subjects	1022.5	40		
Highway	983.5	1	983.5	894.1**
Sex x Highway	.4	1	.4	
Age x Highway	0	1	0	
Sex x Age x Highway	.8	1	.8	
Highway x sub. within groups	37.8	36	1.1	

**$p < .01$

Brake Applications

The descriptive statistics and analysis summary for this variable are given in Tables 11 and 12. The analysis of variance revealed one significant main effect, type of highway, and no significant interactions. Subjects applied the brake an average of 6.0 times per mile on traffic course and .07 times per mile on the interstate course.

Table 11. Brake Applications

Groups	Interstate Course			Traffic Course		
	M	SD	R	M	SD	R
Men over 30	.04	.02	0-.2	5.7	1.6	3.0-8.5
Women over 30	.08	.4	2-.3	5.9	1.3	4.3-9.0
Men under 30	.06	.03	0-.2	5.9	1.3	4.4-8.3
Women under 30	.08	.4	0-.2	6.4	1.5	4.5-9.9
Men	.05	.2	0-.2	5.8	1.5	3.0-8.5
Women	.08	.4	0-.3	6.2	1.5	4.3-9.9
Over 30	.06	.3	0-.3	5.8	1.5	3.0-9.0
Under 30	.07	.2	0-.2	6.2	1.5	4.4-9.9

Table 12. Summary Analysis of Variance Brake Applications

Source	SS	df	MS	F
Between Subjects	44.6	39		
Sex	.7	1	.7	
Age	.5	1	.5	
Sex x Age	.1	1	.1	
Sub. within groups	43.3	36	1.2	
Within Subjects	748.8	40		
Highway	700.9	.1	700.9	539.2**
Sex x Highway	.5	1	.5	
Age x Highway	.5	1	.5	
Sex x Age x Highway	.2	1	.2	
Highway x sub. within groups	46.7	36	1.3	

**p .01

Average Speed

Descriptive statistics and analysis summary for the average speed variable are given in Tables 13 and 14. An examination of the table reveals that the age and type of highway main effects as well as age by highway type interaction were significant.

With respect to the age main effect, the under 30 drivers drove 3.2 percent faster than the over 30 drivers (41.7 mph vs 40.4 mph). The age-highway interaction reflected the fact that the under-30 group drove somewhat faster than the over-30 group on the interstate course (57.7 mph vs 54.8 mph, a 5.3 percent difference), while the reverse was true on the traffic course. On the traffic course, the over-30 group drove only slightly faster than the under-30 group (25.9 mph vs 25.6 mph, a 1.2 percent difference).

As one would expect, subjects drove the interstate course faster than the traffic course, and this accounts for the significant highway main effect. Subjects drove an average 56.3 mph on the former course and an average of 25.8 mph on the latter course.

Table 13. Average Speed

Groups	Interstate Course			Traffic Course		
	M	SD	R	M	SD	R
Men over 30	54.9	2.5	49.4-57.4	25.7	1.3	24.3-27.0
Women over 30	54.7	3.5	53.4-60.0	26.0	.3	25.2-28.0
Men under 30	57.2	1.7	53.8-60.3	25.4	1.2	24.3-28.1
Women under 30	58.2	3.6	53.1-60.9	25.8	.3	24.2-26.8
Men	56.1	2.5	49.4-60.3	25.6	1.3	24.3-28.1
Women	56.5	3.9	53.1-60.9	25.9	.9	24.2-28.0
Over 30	54.8	3.1	49.4-60.0	25.9	1.1	24.3-28.0
Under 30	57.7	2.8	53.1-60.9	25.6	1.1	24.2-28.1

Table 14. Summary Analysis of Variance of Average Speed

Source	SS	df	MS	F
Between Subjects	263.6	39		
Sex	3.3	1	3.3	
Age	35.4	1	35.4	5.7*
Sex x Age	2.3	1	2.3	
Sub. within groups	222.7	36	6.2	
Within Subjects	18900.0	40		
Highway	18684.4	1	18684.4	4061.8**
Sex x Highway	0	1	0	
Age x Highway	48.0	1	48.0	10.4**
Sex x Age x Highway	1.6	1	1.6	
Highway x sub. within groups	166.0	36	4.6	

*p .05

**p .01

Comparison of the Present Study with a Previous One

As mentioned in the introduction, part of the study was designed to be compared to a previous study in which 20 women aged 17 through 29 drove the same interstate course used in the present study. These subjects were approximately the same age as the 10 young women tested in the present study, and both groups contained volunteers from the same office. The studies were run at almost exactly the same time.

Several comparisons were made between the two studies in order to determine whether results obtained in one test vehicle, with a particular experimenter, were in any way consistent with those obtained in another test car with a different experimenter. T-tests were used to make the comparisons. No significant differences were found between the groups with respect to speed change, fine steering, accelerator reversals, or average speed. A significant difference was found between groups with regard to lane changes however ($t = 3.56$ df = 28, $p < .01$).

DISCUSSION

The results of the present study suggest that, in typical ("everyday") driving situations, men and women may handle a car somewhat differently. In general, female subjects were found to make more speed changes, as well as course and fine steering corrections, than their male counterparts. With respect to speed and lane changes, differences were more pronounced on the interstate course. Young females made substantially more fine steering reversals relative to young males, but only slightly more relative to the older men and women. In terms of "smoothness," the results indicated that drives of males were somewhat smoother than those of females, if one uses numbers of speed changes and steering adjustments as criteria (Platt, 1964, Greenshields, 1970). It is possible, however, that the differences observed may have, at least in part, reflected the differential driving experiences of the males and females used in the study. Overall, males had more driving experience (years) than females. Additional research, in which driving experience is held constant, is needed to clarify the present findings.

Since lane changes provided only a crude and indirect measure of the lateral position of the vehicle, it was not possible to tell how various drivers tracked along lane markings or road edges. It is conceivable that some drivers might be willing to tolerate very few deviations from a desired path relative to lane or road-edge markings, and would "work hard" to accomplish their goal by adjusting their steering wheel frequently. Other drivers, on the other hand, might tolerate large deviations, and, correspondingly, move the wheel less frequently. Accurate measures of vehicle roadway position would allow one to determine how well, if at all, lane changes correlate with roadway tracking

In addition to the "steering styles" discussed above, it is also possible that similar response styles may exist for speed maintenance. It would be of interest to determine whether women tolerate more, less, or similar deviations from a desired (set) speed than men.

With respect to the age variable, few differences were found. In general, over-30 drivers made a few more lane changes on the interstate course than drivers under-30. Also, as mentioned above, young women made more fine steering adjustments than older men and women, irrespective of the course. Young men, in contrast, made fewer fine adjustments than the older groups. Although it is possible that experiential differences may have partially accounted for some of the findings, it should be pointed out that this seems unlikely since no significant main effects due to age were found. No explanation of these findings will be offered at this time.

As expected, the type of course driven was the most influential variable in the study, producing large differences with all six dependent variables.

Finally, a comparison of the interstate data with that of a previous study (Soliday and Allen, 1972) revealed that subjects in the two studies differed only in terms of numbers of lane changes made. Since differences were not found with other control variables, it is possible that the observed difference in lane changes may have been due to a mechanical artifact in the sensor rather than differences in the way the studies were run.

REFERENCES

1. Greenshields, B.O. Traffic and highway research and how it can be improved. *Science*, 1970, *168*, 674-678.

2. Platt, F.N. In Greenshields, B.O., and Platt, F.N. Objective measures of driver behavior. Paper presented to the Automotive Congress of the SAE, Detroit, 1964.

3. Soliday, S.M., and Allen, J.A. Control responses of automobile drivers relative to type of highway and steering normally used. Chapel Hill: UNC Highway Safety Research Center, 1972.

4. Winer, B.J. Statistical principles in experimental design. New York: McGraw-Hill, 1962.