A Factor Study of Drivers' Attitudes, with Further Study on Driver Aggression

LEON G. GOLDSTEIN, Department of the Army, and
JAMES N. MOSEL, George Washington University

BACKGROUND AND ORIENTATION OF THE STUDY

● DRIVERS' ATTITUDES are a continuing problem in highway safety. There is much opinion (3, 7, 8, 10, 15, 27, 28, 30) and even some research (13, 16, 24, 25, 32, 34, 35) to support the notion that attitudes play an important role in driver behavior. And driver behavior plays an important role in highway fatalities and injuries. It is believed by many that if we could only build "proper" attitudes into drivers, we would go a long way toward making the highways safe.

But before we can begin to know how to develop "proper" attitudes it would seem essential that we find out first what it is we really should have in mind when we speak of drivers' attitudes. Attitudes toward what? Particularly, what are the basic variables (or dimensions) underlying drivers' attitudes? What are the primary attitude objects? How many are there? Are a drivers' attitudes all good or all bad, or is there variation within the individual from one attitude object to another? Is one generally careful or generally reckless, or are there a host of specifics?

Specific Objective of the Study

The present study was a first exploratory step in an effort to identify the basic variables, or dimensions, underlying drivers' attitudes. And the range of attitude objects is defined to encompass the various aspects of driving. Four factors (or dimensions) were hypothesized:

1. Appreciation of hazard. 2. Social responsibility or conformity. 3. Attitude toward the vehicle itself and its operation. 4. Attitude toward speed and speed limits.

General Plan of Investigation

The broad plan of the study consisted in three steps:

1. Development of an instrument (or instruments) to measure attitudes toward as many as possible of the various aspects of the driving activity: to cover the domain of interest.
2. Collection of data on the attitude measures on a group of drivers whose motivation to manipulate their responses could be minimized. (Attitude measures are almost universally easy to falsify by simply giving the response which is known or believed to be the socially desirable one.)
3. Factor analysis of the attitude measures, including rotation to psychological meaningfulness.

Development of the Instrument - The Drivers' Attitude Inventory

Three major considerations determined the nature of the instrument(s) to be prepared:

1. What are the objects of the driving situation, the attitudes toward which we wish to measure?
2. How are data to be collected - by interview, mail order, or direct administration of a standard form? On what kinds of drivers? How enlist their cooperation and circumvent the operation of facade?
3. The data must be amenable to some kind of factor analysis in order that dimensions may be identified.

A study of the available literature (3, 7, 8, 9, 10, 11, 12, 13, 16, 26, 28, 30, 31, 32, 34, 35) and consultation with people in safety work, led to the realization that the number of specific aspects of driving toward which drivers may have attitudes may be

large indeed. Direct factor analysis of 100 or 200 variables seemed infeasible even if electronic computing equipment were available. A grouping into categories (or clusters) of attitude objects was necessary. Fourteen categories were finally settled on as covering the domain of interest in this study and being surely greater than the expected number of factors. They are presented in Table 1 along with the subheadings that define the clusters for this purpose and indicate the kind of attitude object being included.

TABLE 1

CATEGORIES OF OBJECTS OF DRIVERS' ATTITUDES

1. Speed
   a. In city
   b. On open-highway
   c. Satisfaction derived from driving fast
2. Other users of the roadway
   a. Other drivers (or vehicles)
   b. Pedestrians
   c. Children
   d. Slow drivers
   e. Misbehavior of other users
3. Causes of accidents
   a. Driver's behavior
   b. Road conditions
   c. Mechanical failure
   d. Fatalistic attitude
4. Rules and laws
   a. General conformity
   b. Authority
   c. Enforcement
5. Mechanical traffic controls
   a. Lights
   b. Signs
6. Driver limitations
   a. Age
   b. Use of alcohol
   c. Fatigue
   d. Speed of reaction
7. Cops
   a. Use of authority
   b. Fairness
   c. Interest in safety
   d. Courtesy vs abuse
8. Risk taking
   a. Recognition of hazards
   b. Probability of an accident
   c. Need for preventive (defensive) driving
9. Concept of the "Good Driver"
   a. Ability to make time
   b. Ability to get through traffic
   c. Consideration for others
10. The vehicle itself
    a. Identification with
    b. Enjoyment of operating it
    c. Symbol of status
    d. Maintenance, inspection, care
11. Driver training
    a. Need for special training
    b. Licensing exams
12. Responsibility
    a. To others on the highway
    b. For consequences of own actions
    c. To self as member of family or larger society
13. Passengers
14. Special driving conditions
    a. Night
    b. Bad weather
    c. Heavy traffic
    d. Unfamiliar place

One hundred eighty-eight attitude items were written to measure attitudes in the 14 clusters indicated. For example: Many traffic laws are entirely unreasonable; Most drivers who have accidents are just unlucky; It's a thrill to outwit other drivers. The 188 items were prepared in typed booklet form for a preliminary tryout designed to identify ambiguities and items on which drivers did not differ appreciably. Thirteen drivers well known to the investigator were asked to participate in a pilot study. Instructions provided five possible responses: Strongly agree, agree, undecided, disagree and strongly disagree. An IBM answer sheet was used to record responses.

Comments were solicited in regard to any ambiguities, objectionable items, double-barreled statements or any other difficulty encountered.

On the basis of this pilot run, 80 of the items were revised to some degree and two were discarded. Further valuable findings were as follows:

1. Use of a separate answer sheet is not efficient for other than monitored group administration with proper writing-desk surfaces.
2. To ask any one to respond to some 180 attitude items, each of which takes some thought, time, and soul-searching is asking much, even of friends, and only friends are likely to comply at all.
3. The burdensomeness of the task could be appreciably reduced by using only three categories of response: Agree, undecided, disagree.

Two of the findings were readily incorporated in the final form of the instrument: for each item three response boxes were provided in the booklet and plainly labelled Agree, Undecided, and Disagree. The possibility of reduction in number of items was a knottier problem in face of the desirability of retaining the full coverage of the 14 clusters. In any case, data (rather than judgment) would be needed for any item selection scheme, and if data were available the analysis could be done without prior selection. It was at this point that the choice was made in favor of obtaining data on a group of drivers whose motivation to participate without faking could be maximized over against using a properly determined random sample of drivers from the desired universe, but whose responses to attitude items would be expected to be badly biased by facade.

The instrument used in this study, then contained 186 items, and three possible response positions were provided for each. Instructions for self-administration were provided on the cover page. In addition, ten items of information were asked for: 1. name, 2. age, 3. sex, 4. years driven, 5. miles driven, 6. number of moving violations for which fined, 7. number of accidents, 8. number of accidents for which at least partly at fault, 9. cost of damage or injury in accidents for which partly at fault, and 10. present occupation.

Keying and Scoring of Items

Ideally the "correct" response to such attitude items would be that response which is associated with "good" driving behavior. Were it possible to obtain good criterion data on a very large sample, it might well be possible to key such items on the basis of the sign of the correlation coefficient. The prior history of validities of psychometric variables against accident data (5, 6, 9, 11, 13, 16, 17, 19, 21, 22, 24, 25, 32), or indeed of the unreliability of accident data (5, 11, 16, 17, 19, 22, 24, 25, 29, 32, 36, 37) did not indicate a great likelihood of usefulness of such an approach, especially when the instability of individual item statistics was considered.

The decision was made, then, to key the socially desirable response. For each of the 186 items the socially desirable response would be weighted +1 and the undesirable response zero; "undecideds" would be scored +1 or zero in such a manner as to dichotomize the distribution of responses to an item as close to the median as possible.

In order to identify the socially desirable response, copies of the inventory were mailed to 29 persons active in the field of highway safety, either in research or administratively. An accompanying form letter explained the nature of the study and requested opinions as to the socially desirable response. Eighteen of these experts responded in time to be included in the analysis. On the basis of the consensus of these experts, and the prior judgment of the investigator, nearly all of the items were keyed. Those few items which were not keyed in this manner were left to be keyed on the basis of the direction of their correlation with the clusters to which they belonged.

The Clusters

As indicated above, the purpose of setting up the 14 categories (or clusters) of attitude objects was to assure coverage of attitude areas of interest in this study, and to make possible a factor analysis of the items without having to actually compute and factorize the matrix of 186x185 inter-item correlation coefficients. Any such short-cutting of a factorization of inter-item correlations by means of factoring clusters and extending the analysis to the items makes the assumption that the factors that account

for the inter-cluster correlations also account for the inter-item correlations (14, 38, 39); that is, there can be no more factors found among the items than are found among the clusters. It was strategic to have several more clusters than anticipated factors.

But in order to obtain meaningful cluster scores, the clusters had to be composed of items on which people would agree that those items properly belonged to the respective clusters. Accordingly, five research psychologists, colleagues of the investigator, were asked to sort the items (on cards) according to the list of categories in Table 1 with instructions to make additional categories if necessary.

No additional categories were made. Because it was desirable to have clusters whose meaning was very clear and stable, only those items on which at least five of six judges (including the investigator) agreed were actually assigned to a cluster to be scored with that cluster. Four clusters (5, 6, 12 and 13) came through this process with less than four items, and were thus dropped as clusters. (Further attrition occurred during the analysis when items beyond the .90 - .10 split were removed).

Collection of Data

As originally conceived, the purpose of this research was to study the dimensions of attitudes of general drivers in eastern urban U. S. Much thought was given to methods of obtaining a random sample of such population sufficiently large to justify factor analysis. Considerations of (a) the manipulability of responses to attitude items, and of criterion information, and (b) of the quantity of information desired (186 item responses and ten items of background and experience information - led to the decision to emphasize confidence in the data as obtained, at the cost of generalizability of results. Actually, the generalizability of the factor solution suffers much less than do estimations of population parameters from such accidental samples (33). The decision was made to use as subjects only those drivers who were known personally to the investigator or to a friend or relative of the investigator. It was felt that it would be possible in this way to minimize the threat felt by the subject that information given could be used to his disadvantage, and would thus result in information which would be minimally affected by deliberate manipulation, if not by vagaries of memory.

In the summer of 1955, 507 inventory forms were distributed directly to prospective subject drivers by either the investigator or a friend or relative of the investigator. Returns were made either directly by hand or by mail in self-addressed stamped envelopes. The percentage of completed returns was 64 percent: a total of 323 drivers participated, 254 men, 69 women. About 1/3 of the drivers were from the Camden-Philadelphia area and about 2/3 from the Washington, D. C. area.

Background Data on the Sample

The distributions of age, years driven, miles driven, moving violations for which fined, total accidents, and accidents for which at least partly responsible, are shown in Tables 2 - 7. A few comments on these data seem worthwhile. Modal age of the group (Table 2) is approximately 32; nearly 90 percent are between 25 and 55 years old. Years driven (Table 3) range from less than one year to more than 45, with the mode around 12. Miles driven (Table 4) vary from one thousand to 2. 5 million, and about 80 percent have at least 50, 000 miles of experience. While 183 drivers report zero violations (Table 5), 95 report zero accidents (Table 6); there were 293 violations reported and 592 accidents - twice as many accidents as violations. Of the 592 accidents, at least partial responsibility is reported for 294 of them (Table 7), just about half.

Table 8 shows a distribution of respondents' occupations. The most numerous group are the "miscellaneous" with 123 drivers. Almost certainly the number of professionals (48 psychologists and 24 others) and general clerical (39) are disproportionately large for any other area save, perhaps, Washington, D. C.

Constitution of the Final Clusters

Before scoring the attitude clusters, frequency counts were made for each item for

TABLE 2

DISTRIBUTION OF AGE AS REPORTED BY 322 DRIVERS

Age in Years	f
65-69	1
60-64	8
55-59	8
50-54	12
45-49	26
40-44	44
35-39	63
30-34	83
25-29	55
20-24	17
17-19	5
	322
No data	1

TABLE 3

DISTRIBUTION OF YEARS DRIVEN AS REPORTED BY 323 DRIVERS

Years Driven	f
45-49	1
40-44	4
35-39	6
30-34	17
25-29	34
20-24	49
15-19	62
10-14	73
5-9	46
0-4	31
	323

TABLE 4

DISTRIBUTION OF MILES DRIVEN AS REPORTED BY 318 DRIVERS

Thousands of Miles	f
950-2, 500	7
900-949	0
850-899	1
800-849	0
750-799	4
700-749	1
650-699	1
600-649	3
550-599	0
500-549	11
450-499	2
400-449	3
350-399	6
300-349	16
250-299	19
200-249	37
150-199	32
100-149	55
50-99	55
00-49	65
	318
No data	5

TABLE 5

DISTRIBUTION OF MOVING VIOLATIONS FOR WHICH FINED, AS REPORTED BY 320 DRIVERS

Number of Violations	f
12	1
11	0
10	1
9	0
8	2
7	0
6	4
5	5
4	11
3	12
2	25
1	76
0	183
	320
No data	3

TABLE 6

DISTRIBUTION OF ACCIDENTS AS REPORTED BY 322 DRIVERS

Number of Accidents	f
10	3
9	0
8	7
7	0
6	10
5	10
4	18
3	42
2	61
1	76
0	95
	322
No data	1

TABLE 7

DISTRIBUTION OF ACCIDENTS FOR WHICH AT LEAST PARTLY RESPONSIBLE, AS REPORTED BY 321 DRIVERS

Accidents for which partly responsible	f
7	1
6	5
5	2
4	6
3	16
2	30
1	115
0	146
	321
No data	2

TABLE 8

DISTRIBUTION OF OCCUPATIONS OF 321 DRIVERS

Occupational Grouping	f
Psychologists	48
Other Professionals	24
Post Office Clerks, Carriers, Drivers	46
General Clerical	39
Police	12
Housewives	29
Miscellaneous	123
	321
No data	2

TABLE 9

CORRELATIONS AMONG BACKGROUND AND EXPERIENCE VARIABLES, MEANS AND STANDARD DEVIATIONS
(Decimals omitted)

Variable No.	Name	69[a] Women Drivers M	σ	1	2	3	4	5	246[b] Men Drivers M	σ	1	2	3	4	5
1	Age	34.97	9.03						36.39	9.24					
2	Years Driven	11.68	8.37	75					17.37	8.80	87				
3	Miles Driven	5.43	6.78	43	62				20.74	19.59	43	55			
4	Violations	.17	.64	05	09	36			1.14	1.75	17	21	36		
5	Accidents	.81	1.18	16	20	37	68		2.15	2.06	18	18	20	49	
6	Acc/Resp.	.51	.83	20	20	25	55	88	1.04	1.30	16	16	17	47	79

[a] For N = 69 an r = .24 is significant at .05 level
[b] For N = 246 an r = .13 is significant at .05 level

NOTE: For miles driven the means and sigmas are in units of 10,000 miles.

each response, agree, undecided, and disagree. For each item the "undecideds" were included with agree or disagree in order to dichotomize as close to the median as possible. Items with dichotomies beyond .90-.10 were removed; this left seven clusters for analysis, with one cluster having as few as four items. In five of these seven clusters it was possible to remove items with dichotomies beyond .85-.15. Since the other preliminary clusters either did not survive the judges' clustering, or had items with very little variance (very high p-values) they could presumably be ignored with little loss.

Relationships among Background and Experience Variables, Comparison of Means for Men and Women

For the complete-data cases, the intercorrelations among background and experience variables and the means and standard deviations are shown in Table 9 for men and women separately. In making comparisons between the groups, it must be cautioned that the women are for the most part a relatively low-mileage group. Of the 69 women, 41 reported less than 50,000 miles, but of the 246 men only 24 reported less than 50,000 miles. The mean of miles driven is nearly four times as great for the men.

TABLE 10

CORRELATIONS OF ATTITUDE CLUSTERS WITH BACKGROUND AND EXPERIENCE VARIABLES
(Decimals omitted)

Attitude Cluster	M	σ	Age	Years	Miles	Viol.	Acc.	Acc./Resp.
69 Women								
1. Speed	4.90	1.37	01	12	03	-28[a]	-17	-21
2. Others	9.00	3.24	05	05	-18	-14	-08	-08
3. Causes of Accidents	2.78	.88	-03	-02	-04	-11	03	05
4. Rules and Regulations	15.13	3.21	02	02	-08	-17	-10	-13
7. Cops	7.86	2.66	16	06	-11	-24[a]	-28[a]	-28[a]
9. G.D. Concept	4.84	1.06	11	-08	-12	-20	-12	-12
10. Vehicle	6.55	1.87	07	10	06	-18	-01	-03
246 Men								
1. Speed	4.35	1.75	10	06	09	-06	-03	-05
2. Others	9.20	3.03	06	06	11	02	10	09
3. Causes of Accidents	3.16	.81	-09	-08	02	12	12	15[a]
4. Rules and Regulations	14.02	3.93	13[a]	08	13[a]	-04	04	05
7. Cops	7.51	2.56	19[a]	12	04	-03	03	03
9. Good Driver Concept	4.81	.95	12	08	07	01	02	00
10. Vehicle	6.41	2.01	11	20[a]	26[a]	09	01	04

[a] Significant at .05 level

TABLE 11

CORRELATIONS OF ATTITUDE CLUSTERS WITH VIOLATIONS AND ACCIDENTS, MILES PARTIALLED OUT

Attitude Cluster	69 Women			246 Men		
	Violations	Accidents	Acc./Resp.	Violations	Accidents	Acc./Resp.
1. Speed	-31[a]	-20	-23	-10	-05	-07
2. Others	-08	-02	-03	-02	08	07
3. Causes	-11	05	04	12	11	15[a]
4. Rules and Regulations	-16	-08	-11	-09	02	03
7. Cops	-22	-26[a]	-27[a]	-04	02	03
9. Good Driver Concept	-16	-08	-10	-02	01	-02
10. Vehicle	-21	-03	-05	-01	-05	-01

[a] Significant at .05 level

TABLE 12

INTERCORRELATIONS AMONG ATTITUDE CLUSTERS

	69 Women						246 Men					
Cluster	1	2	3	4	7	9	1	2	3	4	7	9
1. Speed												
2. Others	23						15					
3. Causes of Accidents	07	22					11	17				
4. Rules and Regulations	16	42	30				50	31	15			
7. Cops	22	55	24	57			33	38	11	52		
9. Good Driver Concept	-04	-04	09	21	14		22	05	-04	35	14	
10. Vehicle	06	-16	-10	03	-04	39	09	-07	-05	23	06	21

TABLE 13

INTERCORRELATIONS[a], MEANS, STANDARD DEVIATIONS, AND K. R. -20's OF SEVEN ATTITUDE CLUSTERS N = 315
(Final Factor Residuals in Upper Half)

Cluster Number	Cluster Name	No. of Items	M	σ	K. R. -20	1	2	3	4	7	9	10
1	Speed	7	4.49	1.69	56	03	-01	-01	03	-01	00	-02
2	Other Users	16	9.13	3.09	67	16	02	01	-01	01	-02	01
3	Causes of Accidents	4	3.07	.84	16	07	19	02	-02	01	-02	02
4	Rules and Regulations	20	14.24	3.78	77	46	32	15	04	-01	03	-04
7	Cops	12	7.55	2.61	67	31	42	13	53	01	-01	01
9	Good Driver Concept	6	4.83	.97	13	17	03	-01	32	14	02	00
10	Vehicle	10	6.46	1.98	52	08	-09	-07	20	04	25	02

[a]Decimals omitted

TABLE 14

UNROTATED FACTOR MATRIX[a], F_0

Cluster Number	F_1	F_2	F_3	F_4	F_5	h_2
1	55	-19	33	18	-23	53
2	51	55	22	23	-12	68
3	19	21	08	11	22	14
4	82	-12	13	02	14	73
7	67	29	13	-32	-12	67
9	31	-26	-07	-05	09	18
10	28	-48	-42	-18	05	52

[a]Decimals omitted

TABLE 15

TRANSFORMATION MATRIX[a] Λ, CENTROID SOLUTION TO OBLIQUE SIMPLE STRUCTURE

	A	B	C	D	E
I	19	16	16	28	22
II	-40	39	24	-54	-01
III	29	-61	18	-77	19
IV	44	56	-90	-15	18
V	-73	-37	-28	-11	94

[a]Decimals omitted

Significance tests on the data of this study must be interpreted with caution since a) some of the variables have rather skewed distributions, b) the variables are correlated, so that the significance tests are not independent, and c) the universes of which these groups can be regarded as random samples cannot be stated with precision. It is of interest, rather than of prime importance to the purpose of this research, to examine the data for possible differences between men and women.

Mean age differs by only about one year for the men and women (not significant). Mean years driven is about five years greater for the men; men learned to drive at average age 19 while women delayed until about 23. On the average, the women drove about ¼ as many miles. In that experience their average number of violations is less than ⅙ as great, but the average number of accidents is more than ⅓ as great as men's; and the average number of accidents/responsible is just about ½ as great. That is, on the average, the women had a disproportionately low violation rate per mile and a disproportionately high accident rate per mile, compared with the men. All of these differences between means meet a test of significance beyond the .05 level.

As to the relationships among these variables (Table 9), age and years driven are highly correlated, and significantly more so for the men, .87 versus .75. Years driven and miles driven, are less highly correlated, .62 for women, .55 for men. Neither age nor years driven correlated more than .21 with number of violations, accidents, or accidents/responsible, in either group. Miles driven is generally more highly correlated with violations, accidents and accidents/responsible in the women's group than in the men's (but not significantly so). This is probably a reflection of the difference in phase of driving experience for the two groups. But these correlations are no higher than .37 in any case. The correlation of accidents with violations is significantly higher for women, .68 versus .49; caution must be used in interpreting these correlations, however, since many accidents involve violations, and the same event must often be included in both variables. The high correlation of accidents with accidents/responsible is large attributable to such part-whole relationship. One might expect violations to correlate more highly with accidents/responsible than with accidents, but this is not borne out in either group.

Attitude Cluster Score Means; Comparison of Men and Women

The means and standard deviations of attitude cluster scores are presented in the first two columns of figures in Table 10 for the men and women separately. On the Speed cluster and on the Rules and Regulations cluster the women's mean scores are significantly higher (.05 level). On the Causes of Accidents cluster, the men's mean score is significantly higher (.05 level). This latter difference will take on more meaning when relationships are considered below. None of the other mean differences is significant.

Relationships of Attitude Cluster Scores with Background and Experience Variables

The correlations of attitude cluster scores with background and experience variables are presented in Table 10, for the men and women separately. Interpretation of such relationships obtained in a cross-sectional study is beclouded by the peculiar nature of attitudes in that they can both influence and be influenced by experience. While one interpretation may appear more reasonable than another, the issue can hardly be settled without longitudinal studies.

For the women, the Speed cluster is significantly correlated with number of violations ($r = -.28$), the better (higher) the attitude score, the fewer the violations. Apparently, good attitudes toward speed may deter women from violations of speed laws. The Cops cluster is correlated with number of violations, accidents and accidents/responsible, (r's = -.24, -.28 and -.28 respectively), fewer violations and accidents being associated with better (higher) attitude scores. It would appear that women's experiences with cops by way of violations and accidents may promote undesirable attitudes toward cops.

For the men, attitude toward Rules and Regulations is somewhat correlated with age and with miles driven (each $r = .13$), better attitude scores being associated with

greater age and more miles. Attitude toward Cops is also related to age (r = .19), older men having better attitudes. Attitude toward the vehicle itself is related to years and miles driven (r = .20 and .26 respectively) the better attitudes being associated with greater driving experience. Attitude toward causes of accidents is related to accidents/responsible, and in the positive direction (r = .15), higher (better) attitude scores being associated with more accidents/responsible. Apparently, the very process of recognizing one's responsibility for his own accidents may promote desirable attitudes toward causes of accidents. It is equally possible that realistic attitudes toward accident causation lead to recognition of one's own responsibility for his own accidents. Herein may lie one possible approach to remedial action on the part of public safety agencies.

TABLE 16

CORRELATIONS[a] OF CLUSTERS WITH REFERENCE VECTORS
$V = F_0 \Lambda$

Cluster Number	F_1	F_2	F_3	F_4	F_5
1	53	00	00	00	00
2	01	60	00	-01	-01
3	-13	05	-07	-16	28
4	15	-04	07	18	35
7	00	00	52	00	00
9	06	-07	-01	28	13
10	01	-01	01	68	00

[a]Decimals omitted

TABLE 17

BETA WEIGHTS[a] OF CLUSTERS ON PRIMARY FACTORS
$A = VD^{-1}$

Cluster Name	No.	F_1	F_2	F_3	F_4	F_5
Speed	1	73	00	00	00	00
Others	2	01	82	01	-01	-01
Causes of Accidents	3	-18	06	-10	-17	48
Rules and Regulations	4	21	-05	11	19	60
Cops	7	00	00	81	00	01
Good Driver Concept	9	08	-10	-01	29	23
Vehicle	10	01	-02	01	71	01

[a]Decimals omitted

TABLE 18

INTERCORRELATIONS[a] AMONG PRIMARY FACTORS
$C_F = D (\Lambda' \Lambda)^{-1} D$

	F_1	F_2	F_3	F_4	F_5
F_1	1.00	28	54	10	66
F_2	28	1.00	61	-12	56
F_3	54	61	1.00	08	71
F_4	10	-12	08	1.00	16
F_5	66	56	71	16	1.00

[a]Decimals omitted

TABLE 19

TRANSFORMATION MATRIX $T = F_0 (F_0' F_0)^{-1} \Lambda D^{-1}$
(Transforms P matrix to A_I)

	A	B	C	D	E
1	2.45	.57	-.60	-.04	-1.59
2	.53	2.26	-1.03	.55	-.93
3	-1.51	-.61	-1.04	-.65	3.09
4	-.69	-.69	-.67	-.22	2.25
7	-.64	-1.03	2.95	-.18	-1.09
9	-.24	-.19	-.37	.29	.77
10	.02	.64	-.04	1.33	-.70

Since the effect of facade would be to enhance the size of all the relationships between attitude cluster scores and violations and/or accidents, there is little evidence of it here.

It is of some interest to note that the correlations with violations, accidents, and accidents/responsible are predominantly negative for the women, but predominantly positive for the men. When partial correlation coefficients were computed for these relationships, to remove the effect of differences in miles driven (Table 11), the signs did not change for the women, but, for the men, the correlations with violations were all negative but one. The magnitudes were not greatly affected however. (Regression of the respective variables on miles driven - the variable to be partialled out - could not be said to be assuredly linear or otherwise because of the degree to which the self-reports on mileage were so often grossly rounded).

It must be remembered that the correlations between the attitude measures on the one hand with violations and accidents on the other are considerably attenuated by unreliability, especially of the latter variables. In order to obtain some rough estimates of the unattenuated correlations, a value of .50 was used as a reliability estimate for violations and for accidents, and Kuder-Richardson -20 estimates were rounded upward for estimates of attitude cluster reliabilities. On this basis it would seem reasonable that the correlations for clusters three and nine should be about doubled, and the rest increased by about ½ to ⅔ in order to correct for unreliability in the measures.

TABLE 20

ITEMS USED TO INTERPRET FACTOR 1

No. of Item	Keyed Response	p	Beta Weight on F_1	
120[a]	D	72	1.49	Driving at high speed gives you a thrilling sense of power.
63[a]	A	75	1.36	Most drivers should not be allowed to go over 60 mph.
47[a]	A	49	1.09	The desire for speed is just like a disease.
52[a]	D	82	1.08	Speed limits are not needed in open country.
162	D	81	1.07	It's a thrill to beat other drivers at the getaway.
139	D	85	.90	It's a thrill to outwit other drivers.
85[a]	D	73	.87	If speed limits are reduced any, we might as well go back to the horse.
135	D	86	.82	It's fun to pass other cars on the highway even if you're not in any hurry.
22	D	45	.81	The increased horsepower in the new cars puts a new thrill in driving.
5	D	78	.77	It's fun to beat other drivers at the getaway.
114	D	79	.74	Unless a car has real pep and getaway there is no fun in driving it.
90	D	82	.68	It's fun to maneuver through traffic.
64	D	75	.63	Speed limits are not necessary for careful drivers.
145	A	78	.56	Driving in traffic is no fun.
54	D	68	.54	City speed limits are so low they are frustrating.

[a] Included in the Speed cluster

Relationships Among the Attitude Clusters

The intercorrelations among the attitude clusters are shown in Table 12, for the men and women separately. For only one relationship is there a significant difference (and that at the .01 level) between the two groups: Speed versus Rules and Regulations, r = .16 for women, .50 for the men. In both matrices the intercorrelations are generally rather low. It would seem, then, that the item-clustering was effective and that facade did not operate very strongly, or these values would be much higher.

For purposes of the factor analysis it seemed quite realistic to combine the two groups and use the intercorrelation matrix for all 315 cases. Women do constitute from ¼ to ⅓ of the driving population and we are seeking to identify the basic attitudinal dimensions. Were there enough women, and large differences in intercorrelations, separate factorizations would have been warranted.

Procedure for Main Analysis

Since the primary objective of this study was a determination of the dimensions underlying drivers' attitudes, a factor analysis was the primary method. As indicated earlier, it would have been infeasible to obtain the 186x185 inter-item correlation matrix, to factorize it, and to rotate to simple structure, even if electronic equipment were available. By means of the clustering design described, the problem was reduced to a practicable size: the inter-cluster correlations could be factorized and the solution extended to all of the items. However, one usually sacrifices something by use of short-cut methods, and the risk taken here is that there are likely to be factors among the inter-item correlations which will not be detected among the inter-cluster correlations. If, however, the domain of interest was properly covered by the items, and the judges did a proper job of clustering, such undetected factors among the inter-item correlations should be of very minor nature. A similar point may be made with respect to any of the original clusters which did not survive as clusters: either their items have very little variance (i.e., people do not differ in their responses to them), or there is disagreement as to their items belonging together as a separate cluster. In either case it would seem that any factors which escape detection in this way are likely to be of lesser importance. There always remains the possibility, of course, that other investigators may be more ingenious in the writing of attitude items, and thereby isolate additional factors.

The most widely used and understood method for multiple factor analysis is, of course, Thurstone's centroid method (21, 33, 38, 39). Advantages of other methods, such as the mathematical elegance of Hotelling's principal components solution, were outweighed by either computational complexities or this first consideration.

The main analysis of this study was a factorization of the item responses by means of a centroid analysis on the inter-cluster correlations, rotation to oblique simple structure in the cluster space, then extension of this solution to the items by means of the method developed by Dwyer (14).

The formula for this extension is as follows:

$$A_I = P\ F_0\ (F_0'\ F_0)^{-1}\ \Lambda\ D^{-1}$$

where A_I = the matrix of beta weights on factors in predicting the items

P = the matrix of item-cluster correlations

F_0 = the original centroid solution on the inter-cluster correlations

Λ = the matrix which transforms F_0 to oblique simple structure

D^{-1} = the inverse of the diagonal matrix D, which in turn consists of the reciprocals of the square roots of the diagonal elements of $(\Lambda'\ \Lambda)^{-1}$

This extension of a factor solution to variables which are not included in the original factorization is a "least squares" fit (by row) and has the restriction that the final result yields weights on only those factors extracted in the original solution.

The sequence of steps for the full analysis was as follows (some of the steps are already reported in prior sections):

1. Obtain frequency counts for each item, for agree, undecided and disagree responses.
2. For each item, combine the undecided responses with either the agree or disagree responses in order to dichotomize as close to the median as possible; determine p-values.
3. Remove from clusters those items whose dichotomy is beyond .85 - .15. (For clusters three and nine, use items with dichtomies up to .90 - .10). Also remove those which are not keyed.
4. Score the clusters (+ 1 for socially desirable response, zero for undesirable response).
5. Obtain (tetrachoric) correlation of each cluster with each of the unkeyed items which belong to it and whose dichotomy is not beyond .85 - .15 (except for clusters three and nine).

6. Key the unkeyed items according to the direction of the correlation obtained in step 5, that is, assign a +1 to the response associated with high score on the cluster and zero to the response associated with low score on the cluster.
7. Include the keyed items from step 6 in the respective clusters and rescore the clusters.
8. Obtain Kuder-Richardson (Formula 20) estimates of the cluster reliabilities.
9. Compute intercorrelations of the clusters.
10. Obtain a centroid factor solution on the inter-r's from step 9.
11. Rotate the centroid factor solution to oblique simple structure.
12. Compute biserial correlations of each of the items (whether or not they are included in clusters) with each of the clusters.
13. Extend the rotated solution from step 11 to the items by using Dwyer's method and the biserials from step 12.
14. Interpret the factors - on the basis of the (beta) weights from step 13.

TABLE 21

ITEMS USED TO INTERPRET FACTOR 2

No. of Item	Keyed Response	p	Beta Weight on F_2	
51[a]	D	40	1.16	Large trucks should be kept off heavily travelled roads.
7[a]	D	67	1.09	Truck drivers often hog the road.
46[a]	D	53	1.04	It's easy for truck drivers to bully their way through traffic.
50[a]	D	45	1.00	Big slow trucks are real hazards on the road.
133[a]	D	41	.92	It gripes you to be bluffed by other drivers.
169[a]	D	81	.90	Small foreign cars are a nuisance on the highway.
56[a]	D	56	.89	Cab drivers are a very discourteous lot.
20[a]	D	53	.87	Bus drivers usually bully their way through traffic.
55[a]	D	59	.85	Taxi drivers break every rule in the book in order to make time.
178[a]	A	90	-.76	Hit and run drivers are just plain criminals.
2[a]	D	72	.58	Other drivers hardly let you be courteous.
118[a]	D	72	.57	It's hard to be careful if the other drivers aren't.
107[a]	D	49	.50	Pedestrians often just dare you to hit them.

[a] Included in the "other users" cluster

RESULTS AND DISCUSSION OF MAIN ANALYSIS

The Variables and Their Intercorrelations

The intercorrelations among the seven clusters, their means, standard deviations and K. R.-20 reliabilities for the 315 complete data cases are presented in Table 13, lower half (upper half contains residuals of factor solution). All the clusters except two have satisfactory reliability estimates, and those two are very low indeed: .16 and .13 for clusters three and nine respectively. Since K. R. -20's can be gross underestimates under conditions of more than one factor, these latter figures are regarded with caution. Cluster nine has a correlation of .32 with cluster four, which suggests that its true reliability is higher than .13. Cluster three has a small but

TABLE 22

ITEMS USED TO INTERPRET FACTOR 3

No. of Item	Keyed Response	p	Beta Weight on F_3	
123[a]	D	47	1.41	If traffic cops are nasty you lose respect for the law.
104[a]	A	81	1.29	Most traffic cops are fair minded people.
65[a]	D	76	1.27	After being bawled out by a cop a driver doesn't feel like obeying the law.
61[a]	D	71	1.27	Cops get a kick out of ordering drivers around.
66[a]	D	57	1.18	Police cars should be plainly marked in order to promote careful driving.
13[a]	D	58	1.16	Police cars that aren't marked are just rolling traps.
62[a]	D	77	1.12	It's hard to take orders from cops.
3[a]	D	61	.96	Bossy cops make you want to do the opposite of what they say.
150[a]	D	54	.93	A man ought to stick up for his rights when a cop tries to get tough with him.
39[a]	D	76	.91	Cops look the other way when taxi drivers break the rules.
6[a]	D	55	.89	You can talk your way out of a traffic ticket if you know how.
170	A	88	-.87	Any driver who disregards the rights of others on the highway is unfit to be licensed.
1[a]	D	41	.79	There's no use in arguing with a traffic cop; you don't have a chance.
83	D	89	.60	It must be fun to be a cop and order people around.

[a]Included in the "cops" cluster

significant correlation with accidents/responsible (Table 10). The decision was made to keep these variables in the factor analysis, although they would probably not influence the factor solution very strongly.

The Factor Solution

The centroid factorization was carried out using the KR-20 estimates in the diagonal as reliability estimates, since it was desired to factorize the reliable variance of the clusters, not just the common variance. In order to avoid negative diagonals in the residual matrices (due to underestimates of the reliabilities) use was made of the following formula to adjust the diagonal residuals when they threatened to turn negative on the next extraction:

$$r_{jk} = h_j h_k \cos \Phi_{jk}$$

When solving for h_j, $\cos \Phi_{jk}$ was taken to be 1, r_{jk} the highest residual for the variable in question, and h_k the diagonal entry of variable k.

Five factors were extracted; the centroid matrix and reproduced diagonal elements (h^2) are shown in Table 14, and the final residual matrix is shown above the diagonal in Table 13. Further extraction appeared quite unnecessary.

The transformation matrix Λ, which transforms the centroid solution F_0 to oblique

TABLE 23

ITEMS USED TO INTERPRET FACTOR 4

No. of Item	Keyed Response	p	Beta Weight on F_4	
129[a]	A	47	1.11	The condition of a man's car is a pretty good sign of the kind of man he is.
76[a]	A	44	1.03	A man hasn't much pride if he doesn't clean his car regularly.
77[a]	A	80	.96	Warming up the engine before driving is like being kind to a friend.
80[a]	A	75	.87	Treating the car with care is the mark of a good driver.
111[a]	A	69	.86	Unless the car is in A-1 condition it shouldn't be allowed on the highway.
53[a]	A	47	.83	Dirty windshields indicate sloppy drivers.
33[a]	A	58	.72	One of the greatest joys of modern life is the performance of a good car.
31[a]	A	65	.64	The most important gadgets on a car are the brakes.
100	A	96	.61	The least a man can do for safety's sake is have his car inspected regularly.
109	A	68	.61	The driver of the car is responsible for the behavior of his passengers.

[a] Included in the "vehicle" cluster

simple structure, is presented in Table 15. The result of this transformation, the V matrix, which consists of the correlations of the clusters with the oblique reference vectors, is presented in Table 16.

By post-multiplying the V matrix by D^{-1} (where D is the diagonal matrix consisting of the reciprocals of the square roots of the diagonal elements of $(\Lambda'\Lambda)^{-1}$), the A matrix is obtained, which consists of the beta-weights of the primary factors in predicting the clusters. The A matrix is presented in Table 17. The intercorrelations among the primary factors are presented in Table 18.

From Table 17 we may interpret the five factors in the cluster space. Factor one is identified with the Speed cluster, Factor two with the "Other Users of the Roadway" cluster, Factor three by attitude toward Cops, and Factor four is primarily identified by the Vehicle cluster. Factor five has sizeable weights on Causes of Accidents cluster and on Rules and Regulations cluster. It appears to be an appreciation of the need for rules and regulations in line with a recognition of the causes of accidents - an appreciation of hazard in driving.

Further insight into the nature of the five factors is furnished by their intercorrelations (Table 18). We see here that, (a) Factor four (Attitude toward the Vehicle) is nearly orthogonal to the other four factors, (b) Factor five is highly correlated with Factors one, two and three, and (c) Factor three is substantially correlated with Factors one and two.

Factors in the Item Space

The extension of this factor solution to the items was accomplished by the Method of Dwyer (14), applied to the matrix of item-cluster correlations. The transformation matrix $T = F_0 (F_0' F_0)^{-1} \Lambda D^{-1}$ which was used to post-multiply the matrix of item-cluster

TABLE 24

ITEMS USED TO INTERPRET FACTOR 5

No. of Item	Keyed Response	p	Beta Weight on F_5	
37[a]	D	84	2.56	Automobile accidents are a matter of pure chance.
34[a]	D	50	2.46	Accidents are often caused by conditions beyond the control of the driver.
49[a]	A	87	2.31	Accidents are caused by somebody's mistakes.
158[a]	D	86	1.76	Accidents happen to only those drivers who are "accident prone."
59	D	98	1.54	Dipping your lights to oncoming cars is hardly worth the effort.
119	A	96	1.28	Not stopping for a fire engine or ambulance is keeping help from someone who needs it.
141	D	93	1.22	As long as no one gets hurt there's nothing wrong with breaking traffic laws.
71	D	93	1.21	Modern highways are so good you don't have to worry about conditions of the road when you drive.
176[a]	D	53	1.13	Fines don't stop anyone from breaking traffic laws.
110	D	93	1.05	There is no fun in driving if you have to obey all the rules.
96[a]	A	75	1.03	Anyone who doesn't drive by the rules should be kept off the highway.
41	D	89	.96	Risking your own life in a car is your own business.
173	A	66	.94	It's not reasonable to blame "conditions" for accidents since it's up to the driver to allow for them.
97	A	52	.91	Skill in handling a car is less important to safety than an an attitude of carefulness.
95[a]	D	72	.90	Many traffic laws are entirely unreasonable.
172[a]	D	59	.88	A driver should not be punished for breaking a law that he doesn't know about.
18	A	96	.86	Taking chances while driving is just asking for trouble.
106	D	90	.80	Most drivers who have accidents are just unlucky.
127[a]	D	63	.80	It is impossible to enforce traffic rules that most drivers don't like.
157[a]	D	55	.78	Some traffic laws are enforced too strongly.
17[a]	D	76	.78	It's foolish to signal for a turn when there is no traffic.
32[a]	D	83	.77	Strict traffic regulations are a great nuisance.
177[a]	D	81	.74	It is foolish to have to signal for a turn when there is no traffic.
143[a]	D	76	.70	Since so many people break the traffic laws there must be something wrong with the laws.
10	A	72	.70	Any driver who endangers others on the highway should be treated as a criminal.
102[a]	A	75	.68	Most speed limits are set by people who know what is best.
164	A	84	.65	Passing on hills or curves is just plain criminal.
185	D	88	.65	Traffic laws hold up the flow of traffic rather than help it.
174	A	83	.62	The driver who breaks the law should be held responsible for the accident.
4[a]	A	57	.61	If you don't signal in advance for turns or stops you shouldn't be licensed to drive.

[a] The first four items listed constitute the "Causes of Accidents" cluster; the other starred items are included in the "Rules and Regulations" cluster.

TABLE 25

CORRELATION OF COMPETITIVENESS-AGGRESSION CLUSTER WITH BACKGROUND AND EXPERIENCE VARIABLES

Variable	All Men N = 249-254	Men, 50,000 + Miles N = 227-229	69 Women
	r	r	r
Violations	-.13[a]	-.15[a]	-.21
Accidents	-.12	-.10	-.15
Accidents/Resp.	-.14[a]	-.14[a]	-.17
Age	.13[a]		-.06
Years Driven	.06		.02
Miles Driven	.09		-.01

[a]Significant at .05 level

correlations in order to obtain the beta weights of the items on the factors is shown in Table 19. This extension is a least-squares solution and yields beta weights on factors extracted in the original solution. This makes possible an interpretation of the factors in the item space, and to the extent to which the factors in the item space are covered by the factors in the cluster space, we have, in effect, factorized the inter-item correlations.

In order to interpret a given factor in the item space the following criteria were used to select the items for this purpose:

1. The beta weight on this factor had to be at least .50.
2. This beta weight had to be the highest one for this item.
3. The next lower beta weight for this item must not be larger than half this highest one.

Table 20 presents the critical items for Factor one along with the keyed responses, p-values, and beta weights. Five of the items included in the original speed cluster have beta weights among the highest. It must be cautioned that the rotation carried out in the cluster space made the speed cluster identical with the speed factor, and items which are a part of the speed cluster would be expected to have somewhat inflated item-cluster correlations, and hence inflated beta weights on this factor. The same caution holds for Factors two, three and four, but to a lesser extent for Factor five, because it was rotated with regard to two clusters (Rules and Regulations and Causes of Accidents).

Examination of the items in Table 20 reveals that the common element is not just speed, but competitive speed. Apparently the pre-motor-vehicle spirit characterized by the challenge, "My horse can beat your horse!" is still with us.

Table 21 presents the critical items for Factor two. All of these items are included in the "Others" cluster. This factor seems properly characterized by attitude toward other users of the roadway.

Table 22 presents the critical items for Factor three. Only two of these items were not in the original "Cops" cluster. This is clearly characterized by attitude toward cops.

Table 23 presents the critical items for Factor four. This is clearly the attitude toward the Vehicle itself.

Table 24 presents the critical items for Factor five. This one is not so readily interpreted. It will be remembered that this factor correlates quite highly with all the others except Factor four (Vehicle). Many more items meet the criterion for inclusion here than for the other four factors. The extremely high beta weights for the first four items listed must be regarded with caution since they do in fact constitute the whole of the "Causes of Accidents" cluster. Also, several of the items have very high p-values, beyond .90!

To be sure, attitude toward rules and regulations - or conformity to the law - is represented here, as is also the notion of causality of accidents and the notion of re-

sponsibility. It is not unreasonable that these should all be closely akin, and should correlate with attitudes toward speed, others, and police. An underlying appreciation of the need for regulation, an awareness of the hazards in driving, or just plain care or concern for safety, would seem to characterize this factor. Perhaps further research might well show two or three factors here, but it does not emerge as a very distinct factor in this study.

Because of the mixed findings for the relationships between the attitude clusters and violations and accidents, the factor solution was not extended to these variables.

SUMMARY AND CONCLUSIONS

The primary purpose of the study was to determine the dimensions, or factors, underlying drivers' attitudes. Four factors were hypothesized: (a) Appreciation of hazard, (b) Social responsibility or conformity, (c) Attitude toward the vehicle itself, and (d) Attitude toward speed.

A 186-item attitude inventory was developed to measure the 14 aspects of drivers' attitudes considered to cover the domain. This inventory was administered to 323 general drivers from the Philadelphia and Washington, D. C. areas. After eliminating items with extreme p-values and items on which judges' agreement as to the cluster to which the item belonged was less than five out of six, seven clusters remained for analysis.

A short-cut factor analysis of the items was achieved by factorizing the inter-cluster correlations and extending this solution to all of the items by means of the method developed by Dwyer. Five factors were identified: (a) Attitude toward competitive speed, (b) Attitude toward other users of the roadway, (c) Attitude toward cops, (d) Attitude toward the vehicle, and (e) A general attitude of care or concern for safety. Factors one, two and three are substantially correlated. Factor four (Vehicle) is nearly orthogonal to the others, while Factor five is highly correlated with Factors one, two, and three. Hypothesized factors one and two seem in this analysis to be imbedded in a more general factor of carefulness.

Attitude cluster scores were correlated with background and experience variables for 69 women and 246 men separately. For the women, attitude toward Speed was significantly correlated (-. 28) with number of violations, better attitude scores being associated with fewer violations. Attitude toward Cops was also correlated with number of violations, accidents and accidents/responsible (-. 24, -. 28 and -. 28 respectively), better attitude scores being associated with fewer violations, fewer accidents, etc. Apparently good attitudes toward speed may deter women from violating speed laws, and women's experiences with cops by way of violations and accidents may promote unfavorable attitudes toward cops.

For the men, attitude toward Causes of Accidents was significantly correlated with Accidents/Responsible (+. 15). Apparently the process of recognizing one's responsibility for his own accidents may promote favorable attitudes toward causes of accidents (or, having favorable attitudes toward causes of accidents facilitates recognition of one's responsibility for his accidents). Attitude toward Rules and Regulations was significantly correlated with age (+. 13) and with miles driven (+. 13), better attitudes being associated with greater age and experience. Attitude toward Cops was correlated with age (+. 19), older men have better attitudes. Attitude toward the vehicle was correlated with years driven (+. 20) and miles driven (+. 26) better attitudes being associated with greater experience.

Women's mean scores were significantly higher than men's on attitude toward Speed and attitude toward Rules and Regulations. The men's mean score was significantly higher on Causes of Accidents cluster.

On the average, the women had driven about ¼ as many miles as the men in ⅔ as many years. On the average, the women had ⅙ as many violations, ⅓ as many accidents and ½ as many accidents/responsible. That is, the women had a disproportionately low violation rate per mile, but a disproportionately high accident rate per mile. The ratio of violations to accidents was about 1:2 for the men, but about 1:5 for the women.

Further Analysis on Driver Aggression

When the items in Table 20 were examined for the purpose of interpreting Factor 1, certain of the items appeared clearly to be measuring an attitude of competitiveness, or aggression. And this led to the interpretation of this factor as competitive speed, rather than just speed. Subsequently, these six items (numbered 5, 90, 135, 139, 145 and 162) were scored as an additional cluster, and correlated with background and experience variables. The results are shown in Table 25.

Within the limits of the measures and samples used, it appears that competitiveness, or aggression, is related to violations and accidents for which responsible, at least for the men; greater aggression is associated with more violations and accidents/responsible. Also, as would be expected, this measure is related to age, younger men being more aggressive.

For the women, none of the correlations with violations or accidents is significant, very probably because there are too few cases to detect small relationships. The signs of these correlations, however, are all in the expected direction, and the smallest is always with total accidents, probably because raw number of accidents has lowest reliability. Very interestingly, there seems to be no relationship of age with aggression for the women.

That Years Driven and Miles Driven are not related to this measure of aggression suggests that it is not affected by driving experience, but only (for the men at least) by maturation.

This appears to be an area worthy of attention by researchers, educators, and administrators who are interested in highway safety, particularly when we consider the role of competition in the way of life of the Western world.

ACKNOWLEDGMENT

This paper is based on a dissertation carried out by the senior author under the direction of Prof. Mosel. Any opinions expressed are those of the authors, and do not necessarily reflect official policy of either the Dept. of the Army or George Washington University.

REFERENCES

1. Accident Facts, (National Safety Council, Chicago). 1951 - 1956.
2. Automotive Facts and Figures, (Automotive Manufacturers' Association, Detroit). 1955.
3. Baker, J. Stannard., "Effect of Enforcement and Licensing on Driver Attitude, Symposium: What Can Be Done About Driver Attitudes?" Transactions, National Safety Congress, Vol. 31, pp. 85-86. 1950.
4. Baldwin, David M., "Traffic-Accident Trends," Highway Research Board Bulletin 74, Traffic-Accident Studies. National Academy of Sciences - National Research Council, Publication 265, Washington, D. C. 1953.
5. Bransford, T., Relation of Performance on Drivers' Tests to Automobile Accidents and Violations of Traffic Regulations in the District of Columbia. Unpublished PhD. Dissertation, American University, 1939.
6. Brown, C. W. and Ghiselli, E. E., "Accident Proneness among Streetcar Motormen and Motor Coach Operators," Journal of Applied Psychology, Vol. 32, No. 1. 1948.
7. Buck, Donald S., "Attitude-Key to Accidents." (Also in Highway Research Abstracts, Vol. 22, No. 1, January 1952, pp. 17-19) Commercial Car Journal. January 1951.
8. Case, Harry W., "Attitudes - What are They? How are they Changed? Symposium: What Can Be Done about Driver Attitudes?" Transactions, National Safety Congress, Vol. 31, pp. 75-81. 1950.
9. Case, Harry W., Reiter, Ismar, Feblowicz, Ernest A., and Stewart, R. G., "A Study of the Habitual Traffic Violator." Paper read before The Highway Research Board Annual Meeting, Washington, D. C., January 1955.
10. Cleeton, Glen U., Waits, J. V., and Jensen, M. R., "Panel Discussions: What

Can We Do About Driver Attitudes?" Transactions, National Safety Congress, Vol. 31, pp. 25-30. 1950.

11. Cobb, P. W., "Report to the Highway Research Board on the Automobile Driver Tests Administered to 3,663 Persons in Connecticut, 1936-37, and the Relation of the Test Scores to the Accidents Sustained." Unpublished Report to Highway Research Board, Washington, D. C., July 1939.

12. Conover, Donald W., "Development of Certain Techniques for the Measurement of Driver Attitudes." Unpublished Master's Thesis, Iowa State College, Ames, Iowa, 1947.

13. Dennis, Wayne., "Differential Social Characteristics of Convicted Automobile Drivers," Chapter XVIII in Psychological Principles in Automotive Driving, by Albert P. Weiss and A. R. Lauer. The Ohio State University Studies, Contributions in Psychology No. 11, Columbus 1930.

14. Dwyer, Paul S., "The Determination of the Factor Loadings of a Given Test from the Known Factor Loadings of Other Tests." Psychometrika, Vol. 2, No. 3, pp. 173-178. 1937.

15. Ellison, A. L., Report on 1954 National Safety Congress, Intra-Office Report, Office of the Director of Vehicles and Traffic, Washington, D. C.

16. Eno Foundation for Highway Traffic Control, Personal Characteristics of Traffic Accident Repeaters, Saugatuck, Conn. 1948.

17. Farmer, E. and Chambers, E. G., A Study of Accident Proneness Among Motor Drivers, Report No. 84, Medical Research Council, Industrial Health Research Board, His Majesty's Stationery Office, London. 1939.

18. Forbes, T. W. and Kraft, M. A., "A New Theory of Traffic Accident Incidence." Psychological Bulletin, Vol. 38, p. 531. 1941.

19. Goldstein, Leon G., Van Steenberg, N. J. and Birnbaum, A. H., Evaluation of Instruments to Select Safe Drivers. PRS Report 962, Personnel Research Section, Personnel Research and Procedures Division, TAGO, Department of the Army, Washington, D. C. 1952.

20. Highway Research Abstracts, Highway Research Board (National Research Council) Washington, D. C., Vol. 25, No. 10, p. 13. November 1955.

21. Holzinger, Karl J. and Harman, Harry H., Factor Analysis. University of Chicago Press, Chicago. 1941.

22. Johnson, H. M., "The Detection and Treatment of Accident Prone Drivers." Psychological Bulletin, Vol. 43, No. 6, pp. 489-532. 1946.

23. Lauer, A. R., "Age and Sex in Relation to Accidents." Highway Research Board Board Bulletin 60, Road-User Characteristics, National Academy of Sciences (National Research Council). Publication 244, Washington, D. C. 1952.

24. McFarland, Ross A. and Moseley, A. L., Human Factors in Highway Transport Safety, Harvard School of Public Health, Boston. 1954.

25. McFarland, Ross A., Moore, Roland C. and Warren, A. Bertrand. Human Variables in Motor Vehicle Accidents, A Review of the Literature, Harvard School of Public Health, Boston. 1955.

26. Motor Truck Facts, (Automobile Manufacturers' Association, Detroit). 1955.

27. Selling, Lowell S., "Faulty Attitudes as Factors in Traffic Accidents." University of Michigan, Annual Highway Conference, Proceedings, 27; pp. 164-175, 1941. (University of Michigan, Official Publication, Vol. 43, No. 9, July 24, 1941). Ann Arbor, Michigan.

28. Siebrecht, Elmer B., Measuring Driver Attitudes. Research Contributions to Safety Education, Vol. II, No. 3. 1941. Center for Safety Education, New York University, New York.

29. Slocombe, C. S., "Consistency of Operating Efficiency." Person. Journal, Vol. 8, pp. 413-414. 1930.

30. Stack, Herbert J., "How Can Driver Attitudes be Affected by Education? Symposium: What Can Be Done About Driver Attitudes?" Transactions, National Safety Congress, Vol. 31, pp. 82-85. 1950.

31. The Public's Attitudes on Traffic Safety. A Public Opinion Survey for the National Committee for Traffic Safety, Opinion Research Corporation, Chicago: National Safety Council. 1946.

32. Thorndike, Robert L., The Human Factor in Accidents, with Special Reference to Aircraft Accidents. Project No. 21-30-001, Report No. 1, USAF School of Aviation Medicine, Randolph Field, Texas, February 1951.

33. Thurstone, L. L., Multiple-Factor Analysis. University of Chicago Press, Chicago. 1947.

34. Tillman, William Anthony., "The Psychiatric and Social Approach to the Detection of Accident Prone Drivers." M. S. Thesis, University of Western Ontario, London, 1948.

35. Tillman, W. A. and Hobbs, G. E., "The Accident-Prone Automobile Driver." A Study of the Psychiatric and Social Background, American Journal of Psychiatry, Vol. 106, No. 5, pp. 321-331. November 1949.

36. Uhlaner, J. E., Goldstein, Leon G. and Van Steenberg, N. J., "Development of Criteria of Safe Motor-Vehicle Operation." Highway Research Board Bulletin 60, Road-User Characteristics, Publication 244, National Academy of Sciences, National Research Council, Washington, D. C. 1952.

37. United States Congress. Motor Vehicle Traffic Conditions in the United States. "The Accident Prone Driver," House Document, No. 462, Part VI, Washington, D. C., Government Printing Office. 1938.

38. Wherry, R. J., Campbell, J. T. and Perloff, R., "An Empirical Verification of the Wherry-Gaylord Iterative Factor Analysis Procedure." Psychometrika, Vol. 16, No. 1, March 1951.

39. Wherry, R. J. and Winer, B. J., "A Method for Factoring Large Numbers of Items." Psychometrika, Vol. 18, No. 2. June 1953.