CONSUMER ATTITUDES TOWARD AUTOMOBILE SAFETY MEASURES: A CLUSTER ANALYTIC APPROACH

Frederick Wiseman, Robert Lieb, Mark Moriarty
Northeastern University

1. Introduction

Automobile safety programs, which range from law enforcement to structural design of automobiles, influence not only the safety of the driving public, but also their expenditures. Because consumers are so directly affected by such programs which are implemented by various governmental units, often in conjunction with automobile manufacturers, a national probability survey was conducted by Lieb and Wiseman in January, 1973, to determine consumer attitudes toward a number of existing and proposed automobile safety programs.[1] Questionnaires were mailed to 888 households and after one follow-up postcard, 420 (47 percent) usable replies were received.

The survey results indicated general public support for existing and proposed automobile safety programs. Evidence of this was provided by the following findings:

1. Seventy-seven percent of those respondents who lived in states which had mandatory automobile inspection programs believed that their state's program was effective in promoting automobile safety.

2. Eighty-six percent of the respondents called for a continuation of the leading role played by the federal Department of Transportation in the development of automobile safety programs.

3. While seventy percent of the respondents were not in favor of a proposed 1976 requirement for inclusion of air bags in new automobiles, they were evenly divided as to whether they would purchase an optional air bag at a price of $100.[2]

4. Fifty percent of those surveyed indicated that they would purchase an optional $750 protection package which would make their new automobile "fatality proof."

5. Seventy-two percent of respondents supported a proposed 1975 federal regulation which would require the inclusion of speed-control devices (governors) in new automobiles. Such devices would prevent new automobiles from traveling in excess of 95 mph.

6. Respondents also favored severe penalties for persons convicted of drunken driving offenses. Evidence of this was provided by the fact that 26% of the respondents recommended prison terms for individuals convicted of drunken driving in accidents which resulted in only property damage. This percentage jumped to 56% when the offense involved non-fatal personal injury and to 83% when the accident resulted in fatal injuries.

While the interest of the public in automobile safety was evidenced by a relatively high rate of response to the survey, it was ironic that many respondents failed to take full advantage of existing automobile safety equipment (respondents used seat belts approximately 50% of the time.)

This paper presents the results of subsequent research which was conducted for the purpose of determining whether respondents could be grouped into a small number of homogeneous segments on the basis of their similarity of attitudes and opinions toward automobile safety related issues. The technique used in this effort was cluster analysis. The specific computer program utilized is discussed in the following section.

2. METHODOLOGY

Cluster analysis is a general term for a large class of numerical procedures whose purpose is to define groups of objects which are related to each other based on some measure of proximity. Most variants of the procedure attempt to develop high within group homogeneity and among group heterogeneity in terms of the proximity measure. The proximities between objects may be matching coefficients, correlation coefficients, distance measures, or anyone of a number of other measures, the only requirement being that a rank order of pairwise proximities obtains.

The Johnson Cluster Program used in the analysis is a nonmetric, hierarchical algorithm and the measure of respondent similarity is the correlation coefficient between respondents computed across subjects' questionnaire responses in the sample. Note that instead of correlating variables across sample respondents, the interest is in similarity of respondents or the resemblance of subject profiles across a set of variables. That is, respondents are judged as similar or dissimilar to each other based on the magnitude of the correlation coefficient between them computed on the basis of their responses to the questionnaire.

The Johnson algorithm is hierarchical in that at the initial stage, each subject is his own cluster and at each succeeding stage, the program chooses that pair of subjects which are most similar, predicated on the rank order of proximities. The program adds a new subject to a cluster if the minimum value of its correlations with each of the existing cluster members exceeds the correlation of any two unclustered subjects. If this is not the case, a new cluster of two subjects is formed.

For the Johnson Cluster program, subjects, once having entered a cluster, remain and, as the algorithm proceeds, all clusters merge until one large cluster exists. While no objective rules exists for deciding, on the basis of statistical tests, when the process should terminate, it is inappropriate to consider doing so any way. The implicit a priori assumption is that clusters exist in the first place, and further, the procedure is exploratory in the sense that the clusters are formed from the data and not from objective external presumptions. While rules of thumb are dangerous to suggest since the research questions may be unique in any given context, rules based on minimum tolerable and meaning cluster size seem most appropriate.

Due to the limitations of the clustering program, the entire sample could not be used, but rather only a subsample of 200 respondents. It is with this subsample that the analysis to be reported on in this paper is based.

3. CLUSTERING VARIABLES

Five variables (CV_1, CV_2, CV_3, CV_4, CV_5) were used in order to group survey respondents into homogeneous groups. Each clustering variable was selected to represent a major automobile safety related issue. The variables were a respondent's

CV_1: Opinion as to the nature of the role that should be played by the DOT in setting auto mobile safety standards (1=Major role,...., 5= no role);

CV_2: Current percentage rate of seatbelt utilization;

CV_3: Likelihood of purchasing air bags as optional equipment at a cost of $100 (1=definitely yes,...., 5=definitely no);

CV_4: Likelihood of purchasing an all encompassing $750 total protection package (1= definitely yes,..., 5=definitely no); and

CV_5: Opinion as to the severity of penalties that should be given to convicted drunken drivers (1=light,..., 5=harsh)

Data were also obtained on six supplementary variables (SV) for each respondent

SV_1: Opinion as to whether air bags should be made optional equipment (yes=1; no=0)

SV_2: Opinion as to whether governors should be made mandatory equipment (yes=1; no=0)

SV_3: Current percentage rate of shoulder belt utilization

SV_4: Age (1=under 25; 2=25-34; 3=35-54; 4=55 and over)

SV_5: Income (1=under $7,500; 2=$7,500-$15,000; 3=over $15,000)

SV_6: Education (1=attended grade school; 2=attended high school; 3=high school graduate; 4=attended college; 5=college graduate; 6=graduate degree)

The above supplementary variables were not used in the formation of the clusters, but were used to aid in their description.

4. RESULTS

The clustering procedure produced a total of 8 clusters at a correlation level of .55. That is, on a respondent by respondent basis, responses of each member of a particular cluster correlated at least at the .55 level with the responses of each additional member of the cluster. Out of the 200 total sample members, only 21 (10.5%) did not fall into one of the eight clusters. The mean values for each cluster on each of the five clustering and six supplementary variables, together with the size of each of the groups are presented in Table 1.

From the data in Table 1, the clusters can be described as follows:

Cluster 1 members are opposed to the present role being played by the DOT in setting mandatory automobile safety standards. Further, these individuals show little interest in new safety equipment and all believe that airbags should be made optional rather than required equipment. However, they do believe in the issuance of stiff penalties to those individuals found guilty of drunken driving violations.

Cluster 2 is the most extreme of all clusters as virtually no interest in safety programs is expressed by group members. They do not wear their safety belts and do not plan to purchase airbags or the $750 total protection package. In addition, this cluster indicates the greatest opposition to the present role being played by the DOT and are by far the most lenient of all groups in the area of what penalties should be assessed to drunken drivers. Further, members are substantially older and somewhat less educated than are individuals in most other clusters.

Cluster 3 individuals are in favor of almost any governmental automobile safety program. Virtually all indicate plans to purchase the protection package and airbags if they are made optional equipment. Members are also among the most frequent users of safety belts and believe in strict penalties for convicted drunken drivers.

Cluster 4 members are quite similar to Cluster 3 members except in the area of safety belt utilization. Surprisingly, little use is made of either the seat or shoulder belt. However, all are in favor of airbags being mandatory and all express purchase intentions if they are made optional at a cost of $100.

Cluster 5 contains individuals who give the most severe penalties, usually prison terms to convicted drunken drivers. These people also make frequent use of their safety belts, but, for the most part, are indifferent to other safety measures.

Cluster 6 is similar to Cluster 5 except in the area of safety belt utilization. This segment makes infrequent use of their seat and shoulder belts.

Cluster 7 is also similar to Cluster 5 except that members are much more lenient in the area of drunken driving penalties.

TABLE I

Cluster Means

Variable	1 (n=10)	2 (n=9)	3 (n=10)	4 (n=10)	5 (n=29)	6 (n=14)	7 (n=32)	8 (n=57)
Clustering Variable								
Role of DOT	3.2	3.7	1.0	1.0	1.0	1.0	1.0	1.0
Seatbelt utilization	60%	5%	98%	45%	93%	25%	83%	25%
Airbag installation	3.3	4.4	1.0	1.0	3.2	3.2	3.4	3.2
Protection package	2.8	3.7	1.4	1.4	1.8	2.0	1.8	1.7
Penalties	4.1	1.9	3.9	3.6	4.5	4.1	2.8	2.6
Supplementary Variable								
Airbags optional	1.0	.8	.6	.2	.7	.7	.7	.8
Governors	.7	.4	.7	1.0	.7	.8	.8	.8
Shoulderbelt utilization	10%	3%	40%	13%	33%	10%	28%	8%
Age	2.7	3.7	2.8	2.6	2.7	2.7	2.8	2.6
Income	2.4	2.2	2.3	2.5	2.1	2.0	2.3	2.1
Education	4.3	3.8	4.3	3.8	4.3	4.0	3.8	3.7

TABLE II

Results of Canonical Analysis

Set 1: Group Membership Variables		Coefficient
	X_1	.595
	X_2	.771
	X_3	-.079
	X_4	-.038
	X_5	-.130
	X_6	-.031
	X_7	-.070
Set 2: Clustering Variables		**Coefficient**
CV_1	Role of DOT	.952
CV_2	Seatbelt Utilization	.104
CV_3	Airbag installation	.006
CV_4	Protection package	.030
CV_5	Penalties	-.072

Canonical Correlation	.95
Willes Lambda	.008
Chi Square	789.93
Degrees of Freedom	35
Significance level	.00

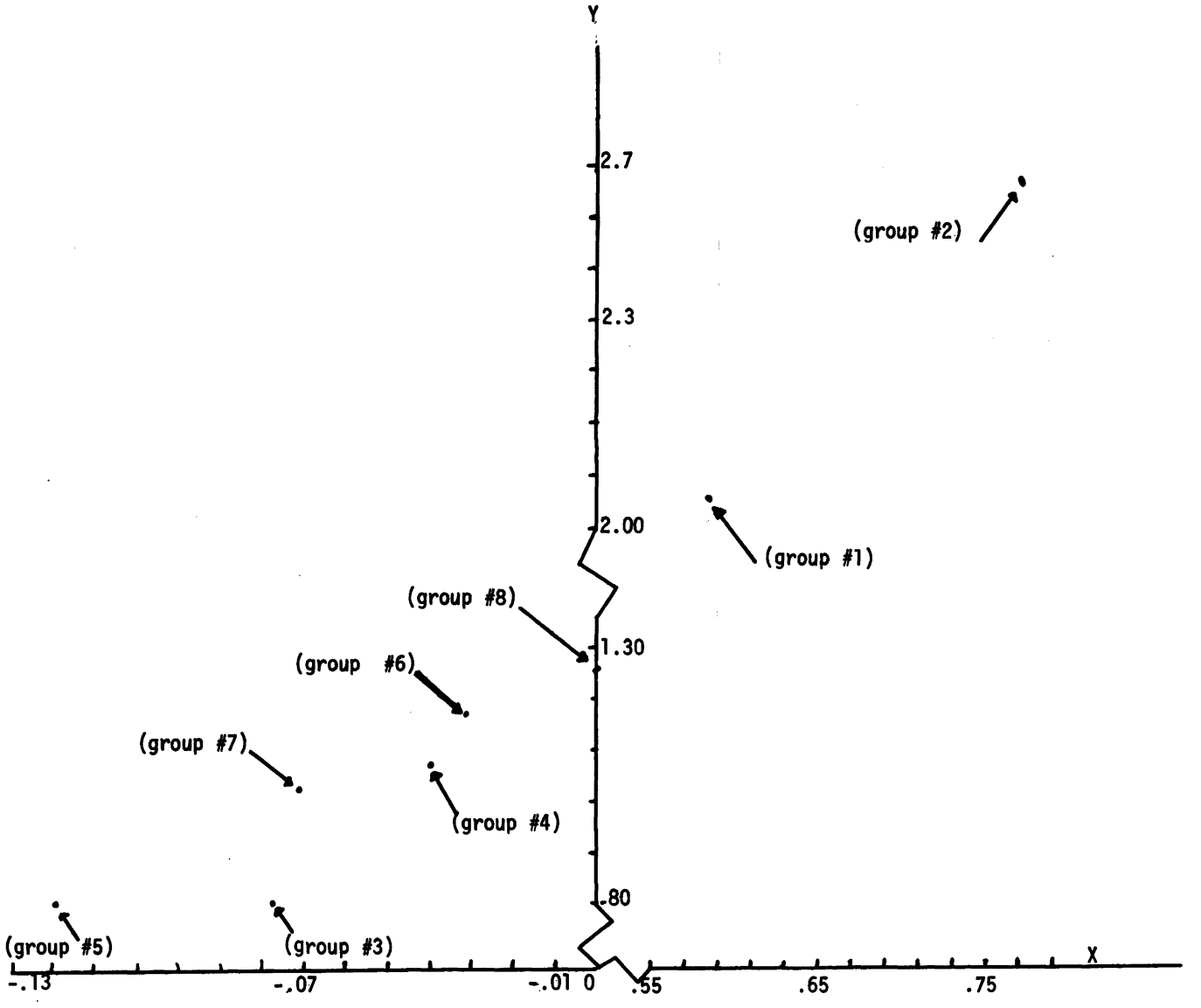

FIGURE 1. Canonical Analysis Plot

Cluster 8 is the largest of all clusters and shows no extreme viewpoints. All, however, believe that the DOT should play a major role in the area of automobile safety. It is interesting to note that this segment makes infrequent use of both seat belts and shoulder belts.

A canonical correlation analysis was performed in order to position the clusters in 2 dimensional space. The two sets of variables used in the analysis were, first, the seven dummy (0,1) variables necessary to indicate cluster membership and, second, the five previously discussed clustering variables. To represent cluster i, (i=1, 2,...7), one takes the canonical coefficient of variable x; as the X co-ordinate and $\sum_j B_j CV_{ji}$ as the Y co-ordinate where:

B_j is the canonical coefficient of the j^{th} clustering variable and

$\overline{CV}_{ji}$ is the mean value for cluster i on the j^{th} clustering variable

Due to the nature of the dummy variables, the X coordinate for cluster 8 will be zero. The results of the canonical analysis and the plot are given in Table 2 and Figure 1, respectively.

As can be seen, the X dimension in Figure 1 appears to be a measure of respondent's opinion as to what role the DOT should play in setting standards. The Y dimension appears to represent the amount of protection that drivers want on the road. Note that clusters 1 and 2 are the most extreme clusters and combined represent about 10% of the population.

CONCLUSIONS

The above analysis has grouped respondents on the basis of similarity of attitudes and opinions toward a number of automobile safety related issues, rather than on socio-economic and demographic profiles. The results indicate that there is considerable heterogeneity across groupings. While there are small extreme clusters holding either strong positive or negative opinions toward governmental automobile safety proposals, the majority of individuals are clustered in groups that have ambivalent attitudes toward a number of these issues.

This lack of public commitment is especially obvious with respect to the airbag and protection package issues raised in this study. In view of this apparent ambivalence, it appears that public opinion may be swayed to support such proposals. If the DOT believes that widespread public support is necessary to bring about future legislation in these areas, it should consider expansion of its public education efforts.

FOOTNOTES

[1]Robert C. Lieb and Frederick Wiseman, "Consumer Attitudes Toward Automobile Safety Programs," Technical Paper 73-ICT-36, presented at the Intersociety Conference on Transportation, Denver, Colorado, September, 1973.

[2]An airbag is a balloon-like device which inflates in the automobile's passenger compartment in the event ofhead-on collisions. The bag is designed to act as a cushion between occupants and the instrument panel. Following impact, the airbag immediately begins to deflate.