Driver Behavior Study—Influence of Speed Limits On Spot Speed Characteristics in a Series Of Contiguous Rural and Urban Areas

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Expedient and safe operation of traffic on various highways and streets has necessitated regulation of motor vehicle speeds. Before scientific warrants can be developed for determination of proper and reasonable speed limits, driver response to regulatory speed limit signs must be ascertained to evaluate the effectiveness of these traffic control devices in modifying vehicular speeds. This field investigation was designed to measure the influence of speed limits on individual driver's speed characteristics in a series of contiguous rural and urban areas. The roadway traveled by the observed drivers was relatively homogeneous in the rural areas. Uniformity of travel existed in the urban centers with the exception of different posted speed regulations.

Analyses of the speed data by appropriate statistical techniques indicated that speed limit signs had relatively little effect in regulating both the central tendency and the variability of vehicle speeds at urban locations. However, these signs were no doubt effective as a means of advising motorists of prevailing speed conditions. This inference concerning the effectiveness of regulatory speed signs was the result of a before-and-after study made to evaluate the influence of altering speed limits in the urban areas.

There was some uniformity in the speed habits of individual drivers in the five rural areas, but little consistency existed in their speeds of travel in the four urban areas. In addition, no significant relationship existed between the individual driver's speeds in rural and urban areas; that is, a fast driver in rural areas was not necessarily a fast driver in urban areas, and vice versa.

The condition of chronic speeding was not observed to any marked degree as the individual drivers exceeding the urban and rural speed limits varied from one location to another. Finally, results of statistical tests showed that variations of spot speeds with time of day were not consistent with respect to both times of the day and locations along the study route.

• THE VEHICULAR speed regulation project, IHR-53, at the University of Illinois has been charged with the development of scientific warrants for the regulation of vehicular speeds. Before an acceptable criterion can be formulated for the establishment of speed-zoning warrants, driver-behavior characteristics must be fully appraised. It is imperative that particular emphasis be placed on the evaluation of driver observance of posted speed regulations. Therefore, the purpose of this research investigation was to ascertain driver observance of reasonable speed regulations on a relatively homogeneous highway having various speed limits along this traffic route.

The influence of posted speed limits on vehicular speeds has been appraised in past studies that were designed to investigate the modification of spot speed characteristics

occasioned by changes in speed limit values. These before-and-after studies are often a routine part of speed zoning programs in many cities and states.

Presence of speed regulations in urban areas apparently has no significant effect on the speeds adopted by drivers. This conclusion was developed in 1948 from speed observations of local and through traffic made in Champaign, Ill., on major streets with no posted speed limits and with posted speed limits of 20, 25, 30, 35, and 40 mph (7).

In New Mexico, where it was found that many communities had established unreasonably low speed regulations, the State highway department conducted an extensive speed zoning investigation based on the 85th percentile speed criterion. This program resulted in the raising of many urban speed limits. Spot speed characteristics were then sampled on these traffic facilities, and it was discerned that the 85th percentile speed values did not increase where the speed limits had been raised. In fact, this percentile measure of the speed distribution often decreased when an unreasonbly low speed limit was increased (1). Similar results were reported for a speed zoning program conducted in the urban centers along US 30 in Nebraska. Speed limit increases of 5 to 20 mph produced no significant changes in the average and 85th percentile speeds (2).

When speed limits were reasonably lowered on rural highways in Wisconsin through properly applied speed zoning, there was generally a substantial reduction in the observed spot speeds of traffic on these roadways (5). From data collected in a comprehensive before-and-after survey of traffic speeds on Illinois highways in 1957 and 1958, reductions in vehicular speeds were observed where new speed zones were established and where existing speed limits were lowered. No changes were apparent in the spot speed characteristics where existing speed limits were raised (3).

Little attention has been devoted to investigating the extent to which individual drivers observe various speed regulations encountered during the course of a trip. A comprehensive study was conducted in New York State over a period of one year in an attempt to relate speeds to both driver and vehicle characteristics. This 1950-51 survey revealed that 46 percent of the speeds over the 85th percentile speed were contributed by the fastest 15 percent of the drivers studied, and further that the driver whose average speed is equal to the over-all average can be expected to exceed the 85th percentile speed about 11 percent of the time (4).

It is evident that additional information is needed on driver behavior in regard to observance of posted speed regulations. This field investigation was uniquely designed to account for the behavioral patterns of individual drivers as they traveled along a relatively homogeneous traffic route having various speed limits posted in the urban areas.

PROCEDURE

Before October 1, 1960, both through and local traffic traveled on US 150 between Urbana and Danville, Ill. Interstate 74, which closely parallels this highway, was opened to traffic on this date. This four-lane, divided facility with controlled access now attracts much of the traffic that formerly used US 150.

US 150 provided an ideal study location for the evaluation of driver observance of posted speed limits. Roadway and traffic features of the highway were practically identical in the rural areas. The environment of the urban centers along US 150 was very similar except for different posted speed regulations in these communities.

Design of Experiment

US 150 is a two-lane, concrete highway with a right-of-way width of 66 ft, a pavement width of 20 ft, and narrow turf shoulders. Alignment of the roadway is mainly straight with a flat profile. Immediately adjacent to one side of the highway is a single-track railroad. The study area is predominantly farmland with very slightly rolling terrain, and "elevator" towns are spaced at frequent intervals along this traffic route. A description of this study route is shown in Figure 1. The 1960 ADT value for this highway section, which was about 16 mi in length, was approximately 4,000 to 5,000 vehicles per day.

Nine speed observation stations were established along US 150. Four of these speed

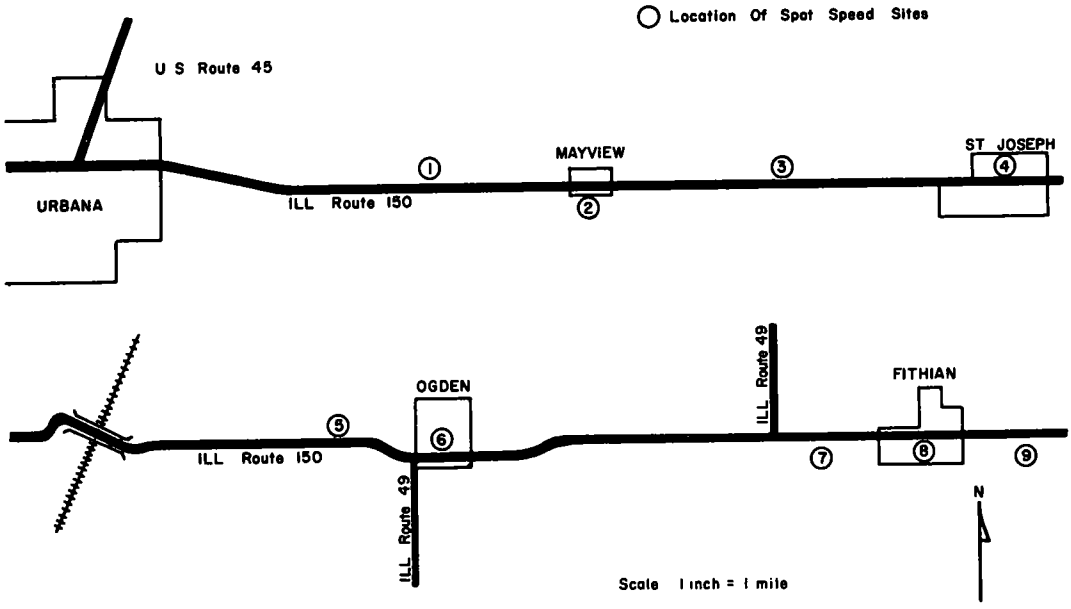

Figure 1. Description of study route.

sites were located in the communities of Mayview, St. Joseph, Ogden, and Fithian with populations of 175, 1,210, 515, and 495, respectively. Roadway and traffic conditions were similar in these towns, but posted speed limits varied among these urban centers. Present speed limits were established on the basis of the 85th percentile speed observed in each community by the Illinois Division of Highways in 1959.

The five remaining speed sites were located in rural areas adjacent to both sides of these towns. Relative positions of these rural and urban study locations are shown in Figure 1. These rural stations were selected on the basis of similarity in roadway and traffic conditions. The regulatory speed limit at each of these rural sites was the absolute 65-mph limit applicable in Illinois.

On September 27, 1960, personnel from the Illinois Division of Highways and the University of Illinois performed this field investigation of driver speed behavior. Two observers were assigned to each speed site. Generally, one observer operated the radar speedmeter, and the other observer acted as recorder. Both personnel and equipment were concealed to the extent permitted by roadside conditions.

Only traffic in the westbound direction was observed for 2½ hr in the morning. As each vehicle passed a site, the following information was noted:

1. Speed in miles per hour,
2. Vehicle type,
3. Last three digits of the license number,
4. Vehicle color, and
5. Time at which the vehicle passed the speed site.

Only the color of the lower portion of the car body and the color of the tractor unit were recorded in cases of multicolored vehicles. This technique of data collection permitted the observed vehicles to be identified individually at the nine study locations.

The same procedure was repeated again for 2½ hr in the afternoon. During this time only eastbound traffic was observed. Starting and stopping times were staggered at individual sites to account for the time required to travel between the respective points of observation. Thus, each through vehicle entering the study section was observed as it passed through the nine check points.

Analysis of Data

Because the purpose of the study was to investigate the relationships between the speeds selected by individual drivers under both rural and urban travel conditions, it was necessary to tabulate the speeds of each vehicle at the nine speed observation stations. Data recorded at each site were matched with data from the other sites on the basis of vehicle classification, last three digits of the license plate number, color of the vehicle, and times at which the vehicle passed the various speed sites.

Approximately 550 vehicles were observed at each site, and of this number 229 vehicles passed all nine sites. Complete records at each site, however, were obtained for only 40 vehicles. The smallness of this sample was mainly due to difficulties encountered in recording the necessary information for vehicles traveling in platoons. Radar speedmeter failures at two study sites for a period of 1 hr also reduced the number of vehicles observed at all nine locations.

In view of the small sample resulting from these operational difficulties, the analysis was confined to those vehicles for which complete information had been recorded at the four urban sites and at a minimum of three rural sites. This procedure yielded a sample size of 160 vehicles.

This sample of 160 vehicles was divided into four groups, indentified as A, B, C, and D. Group A contained those vehicles observed during the first half of the morning study, and Group B represented those vehicles passing the speed sites in the second half of the morning study. Similarly, Groups C and D referred to the first and second halves of the afternoon study. The purpose of this division was to investigate the influences of time of day and direction of travel on the speeds of vehicles observed.

Various statistics, such as mean, standard deviation, and standard error of the mean, were computed at each site to summarize the speed data for time-group samples and total sample. In addition, speeds for the five rural sites were combined for each individual driver to fabricate an average rural condition.

To analyze the speed patterns of each driver at different locations, the following scatter diagrams and correlations were prepared:

1. Individual speeds at each rural site vs individual speeds for the other rural locations,
2. Individual speeds for each urban speed site vs individual speeds at the remaining urban centers, and
3. Individual speeds at each urban location vs the average speed of each vehicle under rural conditions of travel.

This analysis was performed for the total sample and for each time grouping in the

TABLE 1

SUMMARY OF RESULTS

Site	Mean Speed (mph)	85th Percentile Speed (mph)	Speed Limit (mph)	Standard Deviation (mph)	Standard Mean Error (mph)
1. Rural	56.0	63.8	65	7.47	0.72
2. Mayview	39.5	45.7	45	5.94	0.47
3. Rural	56.3	63.4	65	6.87	0.70
4. St. Joseph	31.3	36.5	35	5.01	0.40
5. Rural	55.0	63.0	65	7.73	0.69
6. Ogden	33.3	37.9	35	4.42	0.35
7. Rural	56.4	65.6	65	8.85	0.71
8. Fithian	35.4	40.9	40	5.36	0.42
9. Rural	55.0	62.8	65	7.49	0.58

second and third categories just cited. In the first case, only the complete sample was considered. Speeds of individual drivers were further analyzed at each site to determine the frequency with which each driver exceeded posted speed limits.

TABLE 2

COMPARISON OF BEFORE-AND-AFTER STUDIES

Site	Speed Limit Study, 1959		Driver Behavior Study, 1960		t Statistic
	Speed Limit (mph)	Mean Speed (mph)	Speed Limit (mph)	Mean Speed (mph)	
2. Mayview	45	39.2	45	39.5	0.54
4. St. Joseph	30	30.6	35	31.3	1.42
6. Ogden	40	32.2	35	33.3	2.40[a]
8. Fithian	35	34.9	40	35.3	0.71

[a]Significant at 5 percent level.

TABLE 3

CORRELATION COEFFICIENTS FOR SPEEDS OF INDIVIDUAL DRIVERS AT RURAL SITES

Rural Site	3	5	7	9
1	0.57[a]	0.45[a]	0.43[a]	0.45[a]
3	-	0.77[a]	0.65[a]	0.12
5	-	-	0.62[a]	0.40[a]
7	-	-	-	0.33[a]

[a]Significant at 1 percent level.

TABLE 4

CORRELATION COEFFICIENTS FOR SPEEDS OF INDIVIDUAL DRIVERS AT URBAN SITES

Urban Site	Time Group	4	6	8
2	A	0.32	0.36	-0.01
	B	0.11	0.15	-0.24
	C	0.24	0.34	0.10
	D	0.07	0.25	0.21
	Total	0.14	0.22[a]	0.05
4	A	-	0.43	0.05
	B	-	0.36	0.37
	C	-	0.53[a]	0.11
	D	-	0.31	0.37[a]
	Total	-	0.44[a]	0.27[a]
6	A	-	-	-0.23
	B	-	-	0.36
	C	-	-	-0.28
	D	-	-	0.41[a]
	Total	-	-	0.25[a]

[a]Significant at 1 percent level.

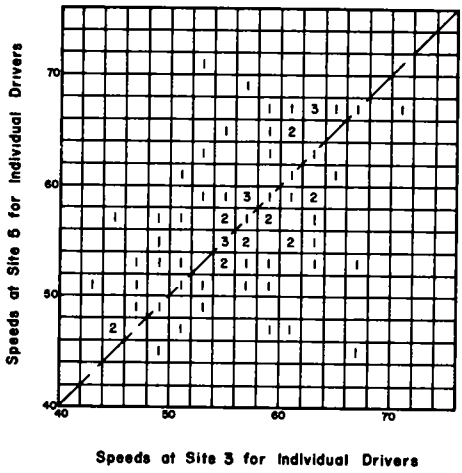

Figure 2. Typical scatter diagram for rural-travel conditions.

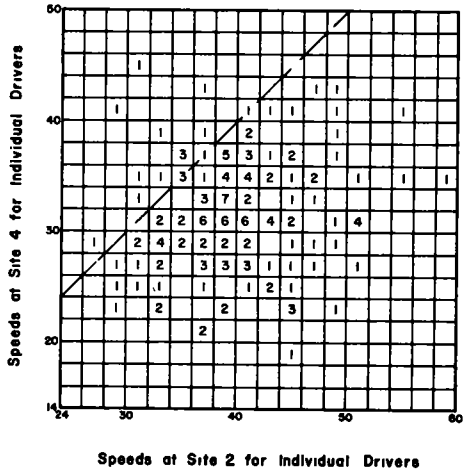

Figure 3. Typical scatter diagram for urban travel conditions.

Several tests of significance were applied to these speed data to make decisions concerning the influence of speed limits on driver behavior and the effect of time of day on spot speed characteristics.

RESULTS

The technique of data collection permitted both macro- and micro-analyses of driver observance of the various speed limits posted along the study route. These investigations were concerned with the over-all observance of speed regulations both before and after speed limit changes and with the speed patterns of individual drivers in the rural and urban areas. In addition, statistical consideration was given to the influences of time of day and direction of travel on vehicular speed characteristics.

Average Speed Characteristics

Various statistics describing the results of this speed survey are given in Table 1.

TABLE 5

CORRELATION COEFFICIENTS FOR SPEEDS OF INDIVIDUAL DRIVERS UNDER RURAL VS URBAN TRAVEL CONDITIONS

Time Group	Average Rural Site vs Urban Site			
	2	4	6	8
A	0.32	0.08	0.24	-0.15
B	0.30	0.22	0.42[a]	0.01
C	0.23	0.14	0.34	0.06
D	0.10	0.17	0.36	0.11
Total	0.31[a]	0.16	0.32[a]	0.03

[a]Significant at 1 percent level.

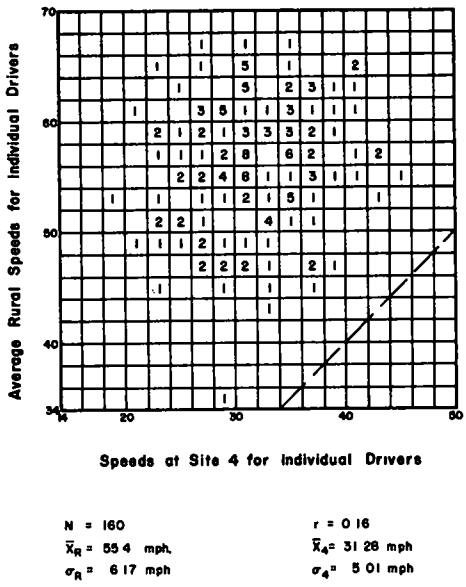

Figure 4. Typical scatter diagram for rural vs urban travel conditions.

The mean speed and the standard deviation represent measures of central tendency and variability, respectively, of vehicular speeds at the nine observation points. The standard error of the mean is indicative of the precision achieved in the experiment. A detailed summary of the study results is given in Appendix A.

The mean speeds for the five rural sites were almost identical. This same relationship also existed among the 85th percentile speeds and among the standard deviations. Thus, similar spot speed characteristics were evidenced in the rural areas. In consideration of the 85th percentile speed as a criterion for speed zoning, a rural speed limit of 65 mph on this highway section appeared to be a realistic and reasonable value.

The average speeds in the urban centers varied considerably from one location to another, although homogeneity of the variance was evident. It was impossible to ascertain the amount of variation in mean speeds attributed to different posted speed limits and that ascribed to confounding variables such as city size and number of commercial establishments.

Speed-Zone Modifications

In the summer of 1959, the Illinois Division of Highways conducted spot speed studies in the towns of Mayview, St. Joseph, Ogden, and Fithian to evaluate the necessity for any modifications in posted speed limits. Based on the results of these speed surveys and the 85th percentile speed as a criterion for speed zoning, the speed limits were left at 45 mph in Mayview, increased from 30 to 35 mph in St. Joseph, decreased from 40 to 35 mph in Ogden, and raised from 35 to 40 mph in Fithian.

Speed data afforded by the speed limit study conducted in 1959 and the driver behavior study performed in 1960 permitted the appraisal of these speed zone modifications

TABLE 6

FREQUENCY OF INDIVIDUAL DRIVERS EXCEEDING THE POSTED SPEED LIMITS (FOR DRIVERS OBSERVED AT ALL SITES)

No. of Speed Limits Exceeded	Drivers		
	No.	Percent	Cumulative Percent
0	19	48	100
1	7	17	52
2	6	15	35
3	6	15	20
4	0	0	5
5	2	5	5
6	0	0	0
7	0	0	0
8	0	0	0
9	0.	0	0

through a before-and-after analysis. The t-test was utilized to ascertain the significance of the difference between the respective mean speeds (6). In this significance testing, a pooled estimate of the variance of the difference between the two means was employed because the Bartlett test for homogeneity of variance led to the general conclusion of homoscedasticity.

TABLE 7

FREQUENCY OF INDIVIDUAL DRIVERS EXCEEDING THE POSTED SPEED LIMITS ACCORDING TO TYPE OF AREA (FOR DRIVERS OBSERVED AT ALL SITES)

No. of Urban Speed Limits Exceeded	No. of Rural Speed Limits Exceeded[a]					
	0	1	2	3	4	5
0	19 (48)	1 (2)	0	0	0	0
1	6 (15)	1 (2)	2 (5)	0	0	0
2	5 (13)	2 (5)	0	1 (2)	0	0
3	2 (5)	0	1 (2)	0	0	0
4	0	0	0	0	0	0

[a]Values in parentheses are percents.

TABLE 8

ANALYSIS OF VARIANCE OF SPEEDS ACCORDING TO TIME OF DAY

Site	Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	$F_{0.95}$
1	Total	6,098.92	109	-	-	-
	Between means	342.18	3	114.06	2.10	2.70
	Within groups	5,756.74	106	54.31	-	-
2	Total	5,623.84	159	-	-	-
	Between means	335.43	3	111.81	3.29[a]	2.67
	Within groups	5,288.41	156	33.90	-	-
3	Total	4,661.56	97	-	-	-
	Between means	655.48	3	218.49	5.12[a]	2.71
	Within groups	4,006.08	94	42.62	-	-
4	Total	4,069.90	159	-	-	-
	Between means	126.02	3	42.01	1.66	2.67
	Within groups	3,943.88	156	25.28	-	-
5	Total	7,503.00	125	-	-	-
	Between means	253.38	3	84.46	1.42	2.68
	Within groups	7,249.62	122	59.42	-	-
6	Total	3,102.38	159	-	-	-
	Between means	480.38	3	160.13	9.53[a]	2.67
	Within groups	2,622.00	156	16.80	-	-
7	Total	12,438.45	157	-	-	-
	Between means	1,006.40	3	335.47	4.51[a]	2.67
	Within groups	11,432.05	154	74.23	-	-
8	Total	4,560.10	159	-	-	-
	Between means	230.25	3	76.75	2.76[a]	2.67
	Within groups	4,329.85	156	27.76	-	-
9	Total	7,211.88	128	-	-	-
	Between means	116.65	3	38.88	0.68	2.68
	Within groups	7,095.23	125	56.76	-	-

[a]Significant at 5 percent level.

TABLE 9

COMPARISON OF SPEEDS AS A FUNCTION OF DIRECTION OF TRAVEL

Site	Mean Speed (mph)		t Statistic
	Westbound	Eastbound	
1. Rural	57.09	55.20	1.32
2. Mayview	38.54	40.25	-1.82
3. Rural	58.78	54.56	3.13[a]
4. St. Joseph	32.30	30.55	2.21[a]
5. Rural	54.86	55.08	-0.16
6. Ogden	35.24	31.93	5.07[a]
7. Rural	56.42	56.36	0.04
8. Fithian	36.60	34.45	2.59[a]
9. Rural	55.62	54.55	0.81

[a]Significant at 5 percent level.

Results of this before-and-after study are given in Table 2. Raising the speed limits by 5 mph in the two urban centers produced no significant increase in mean speeds. However, the mean speed in Ogden increased significantly after the speed limit was reduced from 40 to 35 mph. These results served to indicate that speed limits posted in the urban areas had no realistic influence on controlling the rate of traffic movement. The slight increase in the 1960 mean speeds over the corresponding 1959 values can probably be attributed to the annual rise in the speed of motor vehicle operation.

Individual Driver Behavior

Scatter diagrams prepared for the total sample of 160 vehicles indicated that speeds selected by each driver at the five rural sites were consistent to some degree. That is, fast drivers at one site were often fast drivers at the other rural locations, and slow drivers frequently had low speeds on the rural sections of the study route. This observation was further demonstrated by the significant correlation coefficients that were calculated for these scatter plots. These coefficients of correlation for travel in the rural areas are given in Table 3. The average correlation coefficient for the various combinations of rural sites was 0.48 with a standard deviation of 0.18. On the average, approximately 23 percent of the variation among the speeds of individual drivers in rural areas were explained by regression. With one exception, the correlation coefficients were significant at the 1 percent level. No reasonable explanation appeared to exist for the one inconsistency in these results. A scatter diagram, typical of the individual speed patterns among the various rural sites, is shown in Figure 2.

For the case of urban travel, scatter plots were prepared for the total sample of 160 vehicles and for each of the four time groups. Little uniformity was revealed in the speeds selected by individual drivers when traveling through the four urban centers. Correlation coefficients for the urban studies are given in Table 4 according to time groupings. Summary statistics for the various combinations of urban sites were an average correlation coefficient of 0.23 and a standard deviation of 0.13 for these coefficients of correlation. Only the relationship between individual spot speeds observed in St. Joseph (Site 4) and those recorded in Ogden (Site 6) showed moderate values for the product-moment correlation. This repetition of driver behavior in regard to speed of travel occurred in the two communities having posted speed limits of 35 mph. A typical scatter diagram for individual speed behavior in urban areas is shown in Figure 3. In summary, no consistent pattern of speed characteristics was evident among individual drivers traveling in the study communities.

To investigate the relationship between speeds selected by each driver at both urban and rural sites, scatter diagrams were prepared with the average speed of each driver at the rural sites plotted against their respective speeds in each of the four towns. A

typical scatter plot is shown in Figure 4 for rural vs urban travel conditions. The speed for an average rural site was calculated by averaging the three to five rural speeds observed for each individual driver. Because significant correlations were evidenced between individual speeds at the five rural study locations, the average rural speed of each driver was considered representative of his speed habits in rural areas.

Correlation coefficients obtained for this comparison of rural vs urban speeds are given in Table 5. As indicated by the low degrees of correlation, it was deduced that individual drivers observed in this speed investigation did not operate their vehicles in a consistent manner in regard to rate of travel under rural and urban conditions. A fast driver in an urban center was not necessarily a fast driver on rural sections of the highway. In like fashion, a slow driver in the one area was not in consequence observed operating at low speeds in the other area. The average correlation coefficient for this comparison of rural versus urban travel was 0 20 with a standard deviation of 0.14.

Speed Limit Violations

An analysis of the speed data was made to ascertain the frequency with which individual drivers exceeded speed limits posted along the study route. The results afforded an interesting insight into driver behavior, particularly in regard to the fact that the 85th-percentile-speed criterion for establishing speed limits is predicated on the assumption that 15 percent of the drivers are violators of speed regulations. These findings are summarized by the individual frequencies of violation in Tables 6 and 7.

If the condition of chronic speeding existed, then approximately 85 percent of the drivers would have exceeded no speed limits, and about 15 percent would have violated all nine speed regulations. However, the data given in Table 6 indicated that 52 percent of the drivers violated at least one speed limit for the nine points of observation. The maximum degree of violation was the case of two drivers who exceeded five speed limits. Only 38 percent of those drivers who were observed traveling faster than the speed limit exceeded more than two speed limits. It was inferred that many drivers exceeded a few speed limits, but few drivers exceeded many speed limits. Similar results were reported by Lefeve (4) in a study of speed habits observed on a rural highway. More than one-half of the drivers who had their speeds measured as many as seven times could be expected to exceed the 85th perentile speed at least once.

To refine this analysis of speed limit violations further, the data in Table 7 were separated according to type of area. This refinement showed that 50 percent of the drivers violated speed limits in the urban centers, whereas only 20 percent exceeded speed limits posted in the rural areas. This discrepancy was explained by the findings of the analysis of individual driver behavior. The high degree of uniformity in operating speeds for the individual drivers in rural areas indicated that few drivers traveled consistently at high speeds and exceeded the rural speed regulations. In comparison, the low correlation for speed habits in urban areas implied that many drivers operated at high speeds in some communities and at low speeds in others. This behavioral pattern resulted in more individuals violating urban speed limits along the study route.

As evidenced by the data compiled in Table 7, the maximum numbers of speed limit violations by an individual driver were three out of five for the rural speed limits and three out of four for the urban regulations. This fact is probably explained by the greater heterogeneity in urban speed patterns as compared to the driver speed behavior in rural areas.

Time of Day

In an attempt to discover any significant variations in vehicular speed characteristics with time of day and/or direction of travel, an analysis of variance was performed to test the hypothesis that the mean speeds of the populations delineated as Time Groups A, B, C, and D were equal (6). A priori knowledge of spot speed characteristics permitted the assumption of normal populations. Results of the Bartlett test for homogeneity of variance were previously reported to indicate the same variance for the four populations. The analysis of variance test is summarized in Table 8.

Average speeds for the four time groups were significantly different at two rural and three urban locations. These findings did not permit the ascertaining of variations in spot speed characteristics according to various time periods of the day. These significant differences in mean speeds for the different times of the day appeared to be sporadic in time and inconsistent with respect to site location. It is quite possible that some confounding variables were in operation at particular times and at certain locations to produce these significant differences in these central measures of the speed distributions.

Direction of Travel

Speed information collected in this research investigation was appraised to assess any modifications in speed statistics occasioned by direction of travel. The t-test was employed to analyze statistically the difference between the mean speeds for the morning and for the afternoon at each study site (6). Again, the nonsignificant results of the Bartlett test for homogeneity of variance allowed the use of a pooled estimate of the population variance for the t-test. Table 9 contains the results of this testing of significance.

Only traffic in the westbound direction was observed in the morning. The speed sample in the afternoon was composed of vehicles traveling in the eastbound direction. The results of the t-test were too varied to justify any generalization on mean speed variations with direction of travel. The westbound and eastbound speeds were significantly different for four sites and not significantly different for the remaining five locations. No doubt, other variables including time of day assisted in producing the observed variations.

CONCLUSIONS

The conclusions inferred from the results of this driver behavior investigation are valid only for the individual drivers sampled on the traffic route studied. However, the real benefits of research are realized through inferences made about the entire population of motor vehicle drivers. This technique is predicated on the assumption that a sample is randomly chosen and representative of the population under study. In this perspective, the following conclusions were drawn from the study results:

1. The presence of speed regulations in urban areas had no significant influence on the central tendency and variability of spot speed characteristics. As a result, posted speed limits were not effective as a traffic control device in regulating the rate of motor vehicle movement through urban centers. This conclusion does not remove the desirability of having advisory speed limits posted along the traffic route to assist unfamiliar drivers.
2. The individual driver had variable speed habits; that is, he was not consistent in his selection of operating speeds. Although the rate of travel for each driver assumed some uniformity in rural areas, no definite speed pattern was discernible for urban travel. In addition, a fast driver in rural areas was not necessarily observed as a fast driver in urban areas. The converse of this finding was also true for slow drivers.
3. At any single location approximately 15 percent of the drivers exceeded the posted speed limit; however, over 50 percent of the observed road users violated the speed regulations at one or more of the nine study sites. Therefore, enforcement activities designed to apprehend the fastest 15 percent of the drivers would not be realistic in curtailing the operation of motor vehicles at speeds in excess of the posted speed limit.
4. Chronic speeding was not evident among the drivers sampled. In most instances, the violation of an urban speed limit seemed to be a chance event, and few drivers exceeded the speed regulations posted in rural areas. Only 20 percent of the motor-vehicle operators exceeded more than two of the nine speed limits. The two individuals who exceeded five of the nine speed regulations represented the maximum degree of speed limit violation.
5. More drivers violated speed limits in urban centers than in rural areas. Uniformity of traffic operations in urban areas is difficult to achieve because not only do

drivers vary among themselves but each individual driver is subject to considerable variation in his urban speed habits.

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Appendix

COMPLETE SUMMARY OF RESULTS

Site	Time Period A				Time Period B				Time Period C				Time Period D				Total Sample			
	N	$\bar{X}$	S	SE	N	$\bar{X}$	S	SE	N	$\bar{X}$	S	SE	N	$\bar{X}$	S	SE	N	$\bar{X}$	S	SE
1	19	59.79	5.51	1.30	26	55.12	9.29	1.86	30	54.83	7.23	1.34	35	55.51	6.29	1.08	110	55.97	7.47	0.72
2	31	39.65	5.06	0.92	36	37.58	6.95	1.17	44	41.59	5.13	0.78	49	39.04	5.71	0.82	160	39.53	5.94	0.47
3	21	61.09	6.25	1.40	20	56.35	7.11	1.63	27	54.48	5.06	0.99	30	54.63	7.10	1.32	98	56.33	6.87	0.70
4	31	32.45	4.74	0.87	36	32.14	5.58	0.94	44	30.84	5.12	0.78	49	30.29	4.44	0.64	160	31.28	5.01	0.40
5	21	57.48	8.15	1.82	31	53.10	8.19	1.50	40	55.45	7.80	1.25	34	54.65	6.19	1.08	126	54.99	7.73	0.69
6	31	35.42	3.68	0.67	36	35.08	4.75	0.80	44	32.70	3.95	0.60	49	31.22	3.88	0.56	160	33.31	4.42	0.35
7	31	57.65	7.99	1.46	36	55.36	8.92	1.51	43	59.72	9.41	1.45	48	53.35	7.64	1.11	158	56.39	8.85	0.71
8	31	37.10	5.78	1.06	36	36.17	6.99	1.18	44	33.80	3.81	0.58	49	35.02	4.16	0.60	160	35.35	5.36	0.42
9	27	56.81	5.92	1.16	31	54.58	9.74	1.78	33	54.91	6.29	1.10	38	54.24	7.08	1.16	129	55.03	7.49	0.58
Avg Rural	31	57.77	5.34	0.97	36	54.53	7.16	1.21	44	56.05	6.41	0.98	49	54.12	5.05	0.73	160	55.45	6.17	0.49