Situational Characteristics and Turn-Signalling Behavior

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Turn-signalling was chosen as an area of driver behavior worthy of intensive study. In this paper, the turn-signalling behavior of 10,467 drivers who turned at seven different intersections during daylight hours in the Greater Lansing area was related to various situational characteristics such as type of intersection, direction of turn, presence of following traffic, etc. The major findings were: (a) turn-signalling was significantly influenced by type of intersection; (b) female drivers generally signalled more frequently than male drivers and both generally signalled left turns more frequently than right turns; (c) turn-signalling behavior was not related to time of day, presence of preceding traffic and/or following traffic, or the signalling behavior of the preceding car.

● THE STUDY reported here was an exploratory one designed to provide some insight into the factors affecting the frequency of signalling for a turn by the driver of a motor vehicle.

The choice of turn-signalling behavior as an area of investigation was not a haphazard one. The assumption was made that driver behavior on the highway is an important area of study not only for the student of human behavior but also for those interested in efficient highway design and effective traffic regulatory and enforcement procedures. Turn-signalling behavior was selected for study because it seemed to provide certain advantages not readily found in most driver behavior situations.

First of all, turn-signalling could be observed in field situations with little if any distortion of the naturalistic situation. Also, a high degree of accuracy could be obtained in measuring this behavior and a number of related factors while using a minimum of equipment.

Second, it appeared likely that turn-signalling behavior would be related to a number of situational and individual characteristics. For example, turn-signalling, properly utilized, could serve as a communication channel between driver and driver and between driver and pedestrian about certain specific features of the traffic movement. Whether turn-signalling is, in fact, used to communicate intention to turn and under what circumstances it is so used was one of the questions that required investigation. Other motivations or habit patterns may equally well be hypothesized as factors relevant to turn-signalling. It might be related to attitudes resulting from law enforcement policies of a community, or to the felt "dangerousness" of a turning movement at a given intersection; or it might be related to individual personality characteristics or to driving habits that are relatively consistent from situation to situation for a given person.

Thus, it can be seen that turn-signalling was chosen for study not only for its own importance but also on the expectation that a systematic and analytic investigation of this behavior would yield suggestions pertinent to the understanding of driver behavior in many other traffic situations.

In this paper we shall describe the results obtained from exploring relationships between situational characteristics (such as type of intersection, direction of turn, presence of preceding and following cars, etc.) and the frequency of turn-signalling by drivers of passenger cars. No characteristics peculiar to the individual, with the exception of sex, are considered.

METHOD

General Procedure

A total of 120 hours of observations were made at seven different intersections in the Greater Lansing (Michigan) area. Four intersections were studied from mid-July to mid-August, 1956 (Sites 1-A and 1-B, 2-A and 2-B, 3 and 4). (See below for descriptions.) Preliminary analyses were made of the data obtained at these intersections. In order to replicate the findings and to test hypotheses derived from the summer data, three new intersections (Sites 5, 6-A and 6-B, and 7) were observed from mid-October to mid-November, 1956, and additional data were collected at a site previously studied (Site 1-A).

All data were collected during daylight hours and in good weather (no rain, fog or snow). On a few occasions the road was still wet from a previous rain. Initial observations were made during the early afternoon period. Additional observations were then made at other time periods in order to determine whether observations made at different times of day could be compared. The results obtained were consistent in indicating the lack of relationship between turn-signalling frequency and time of day. (Details of the comparisons are given in the Results section.) In general, observations were made during the early afternoon period (1:00 to 3:30 PM) unless checks were desired on signalling frequency at other times of day or unless the volume of turning traffic was so low during that time period as to make observations uneconomical.

The total number of hours of observation for each site is given in the site descriptions below. These were determined by the time required to obtain stable estimates of male signalling frequency, the number of check observations that were being made at that site, and by the feasibility of observing both right and left turning cars at the same time.

Subjects

The 8,319 male drivers and the 2,148 female drivers of passenger cars who turned at the intersections under study served as subjects.

Observation Sites

Observation sites were selected on the basis of several criteria. Since this was an exploratory study, a wide variation in type of intersection was felt desirable. On the other hand, an attempt was made to replicate some intersection features in order to obtain an estimate of their importance. Generally speaking, pedestrian traffic was quite low at all observation sites and an effort was made to avoid obtaining observations during peak pedestrian traffic periods. Both left and right turns were studied at each site unless otherwise noted. Data obtained on opposing legs of an intersection were combined since statistical tests indicated that opposing legs at the sites studied did not differ significantly in signalling frequency.

Site 1 was the intersection of two two-lane roads at a two-way stop near the center of the Michigan State University campus. The east-west road (Auditorium) was the secondary one; the north-south road (Farm Lane) was the primary one. Site 1-A observations were made on the east leg (15.5 hr); Site 1-B observations were made on the south leg (7.5 hr). Relatively few cars used the west leg. Posted speed limit was 25 mph.

Site 2 was the intersection of two two-lane roads at a two-way stop at the edge of the campus. The east-west road (Shaw Lane-Marigold) was the secondary one; the north-south road (Harrison) was the primary one. Site 2-A observations were made on the east leg (14.7 hr); Site 2-B observations were made on the north and the south legs (6.5 hr). The west leg carried considerably less traffic than the east leg. Posted speed limit was 25 mph, but it was often exceeded on Harrison which bears much traffic bypassing the campus.

Site 3 was the intersection of a four-lane undivided major highway (U.S. 16) and a two-lane road (Hagadorn) at a stoplight intersection about .4 mile to the east of the city limits of East Lansing. Site observations were made of left turns only from the highway (west leg) into the two-lane road (12 hr). Posted speed limit was 35 mph at the intersection and 45 mph just to the east of the intersection.

Site 4 is the intersection of a six-lane divided street (Grand River, also U.S. 16) and one of the major access roads to the campus (Haslett) at a multiple stoplight intersection. The access road on the campus side is three lanes wide (two outbound and one inbound) but decreases to two lanes within 50 yds of the intersection. Observations were made of right turns only from Grand River into the campus (7.5 hr). The intersection is within the city limits of East Lansing. Posted speed limit is 25 mph.

Site 5 was a stoplight intersection at the edge of campus with two-lane legs to the south (Harrison) and the west (Kalamazoo) and four-lane legs to the north and east of the intersection. Observations were made on the south leg (3.5 hr). Posted speed limit was 25 mph on the north-south road and 35 mph on the east-west road. This site is the next four-leg intersection north of Site 2 on Harrison.

Site 6 was the intersection (Cedar and Mt. Hope) of a four-lane divided expressway-type road (running north-south) with a specially widened street (running east-west). The expressway (also U.S. 127) in addition to its four lanes for thru or right turning traffic had a special lane for left turning cars made by cutting away the medial strip beginning about 50 yd from the intersection on both the north and south leg. A special left turn light controlled left turning cars and a portion of the signal light sequence was for left turns only from the expressway. Site 6-A observations were made on the north and the south legs (20 hr). Access was not controlled on the expressway and posted speed limit was 25 mph.

The intersecting street was normally a wide two-lane street. It was widened beginning about 50 yd from the intersection to provide a left turn, a thru, and a right turn lane for outbound traffic and one lane for inbound traffic on both the east and west leg. Pavement legends beginning about 40 yd from the intersection designated the left turn, thru and right turn lanes. Part of the expressway curb had been cut back for about 30 yd to facilitate right turns from the east-west street onto the expressway. Site 6-B observations were made on the east and west legs (22.5 hr). Posted speed limit was 25 mph.

The intersection is within the city limits of Lansing but well outside the central business area. Pedestrian traffic was controlled by pedestrian signals.

Site 7 was an intersection formed by the termination of the expressway described in Site 6 with the regular street system of Lansing. To the south of the intersection was the four-lane divided expressway (Cedar); to the north was an undivided four-lane street (Larch). The intersecting east-west street was four lanes wide and undivided (Kalamazoo). Site observations were made on the north and south legs (11 hr). The phasing of the stoplight was such that all other traffic was stopped when either the north or the south leg had the green light. Thus, there was no impediment to either left or right turns except that caused by pedestrian traffic. There were no special turning lanes or pedestrian signals. The intersection is close to the central business area of the city but not within it. Posted speed limit was 25 mph at the intersection and 35 mph just to the south of the intersection.

Observation Procedure

During any period of observation the following information was obtained for all cars turning from a given leg of an intersection or for all cars turning in a given direction from a given leg of the intersection: (a) signal to turn by observed car; (b) direction of turn; (c) sex of driver; (d) presence of a motor vehicle 100 ft or less behind the turning car when it began its turn; (e) presence of opposing traffic within 100 ft of the intersection; (f) phase of stoplight (red or green-yellow) when there was one. Information was also recorded on both turning and non-turning vehicles in a way that permitted the presence of a motor vehicle 100 ft or less ahead of the observed car to be determined.

The observer stationed himself near the intersection where the required observations could best be made. In most cases he was diagonally across the intersection from the observed traffic movement. At other times he stood 100 ft before the intersection along the leg being observed. During the early stages of this study two observers were used for each leg since data in addition to that described here were also being collected. Later, one observer was required per leg and two legs of an intersection were observed simultaneously.

TABLE 1

TURN-SIGNALLING FREQUENCIES AND PERCENTAGES AT THE VARIOUS STUDY SITES

Site		Right Turns Sig.[a]	N. Sig.[b]	% Sig.	Total	Left Turns Sig.	N. Sig.	% Sig.	Total
1-A	M[c]	35	106	25	141	439	480	48	919
	F[d]	19	46	29	65	111	59	65	170
1-B	M	285	275	51	560	91	56	62	147
	F	60	49	55	109	13	3	81	16
2-A	M	438	616	42	1054	174	136	56	310
	F	115	172	40	287	52	15	78	67
2-B	M	108	61	64	169	334	145	70	479
	F	9	7	56	16	44	17	72	61
3	M	—	—	—	—	382	62	86	444
	F	—	—	—	—	113	20	85	133
4	M	327	243	57	570	—	—	—	—
	F	135	60	69	195	—	—	—	—
5	M	53	54	50	107	141	63	69	204
	F	25	4	86	29	41	13	76	54
6-A	M	274	199	58	473	521	448	54	969
	F	58	45	56	103	215	120	64	335
6-B	M	138	272	34	410	497	191	72	688
	F	62	76	45	138	141	46	75	187
7	M	103	91	53	194	296	188	61	484
	F	36	18	67	54	85	46	65	131

[a] signalling
[b] not signalling
[c] males
[d] females

Michigan state law requires that intention to turn be signalled by either hand signal or electric signal but does not specify the distance this signal must be given prior to turning or make a distinction between a signal for a left turn and one for a right turn. Therefore, a driver was designated as signalling if he blinked his left or right turn signal light or gave any hand signal, except a hand signal for stopping, regardless of the direction of turn.

Reliability of Observations

The reliability of the observations was checked by determining the percent of agreement between two observers observing the same traffic. Percent of agreement of 99 percent or better was obtained for total number of cars turning, number of cars signalling, number of cars not signalling, sex of driver and direction of turn. All other observation categories gave percent of agreement of 93 percent or better. The cate-

TABLE 2

STATISTICAL COMPARISONS OF MALE TURN-SIGNALLING AT THE VARIOUS STUDY SITES

Sites	1-A	1-B	2-A	2-B	3	4	5	6-A	6-B	7
1-A	—	<u>.01</u>	<u>.01</u>	<u>.01</u>	—	<u>.01</u>	<u>.01</u>	<u>.01</u>	NS	<u>.01</u>
1-B	.01		.01	<u>.01</u>	—	<u>.05</u>	NS	<u>.05</u>	.01	NS
2-A	.01	NS		<u>.01</u>	—	<u>.01</u>	NS	<u>.01</u>	.01	<u>.01</u>
2-B	.01	NS	.01		—	NS	.05	NS	.01	.05
3	.01	.01	.01	.01		—	—	—	—	—
4	—	—	—	—	—		NS	NS	.01	NS
5	.01	NS	.01	NS	<u>.01</u>	—		NS	.01	NS
6-A	.01	NS	NS	<u>.01</u>	<u>.01</u>	—	<u>.01</u>		.01	NS
6-B	.01	.05	.01	NS	<u>.01</u>	—	NS	.01		<u>.01</u>
7	.01	NS	NS	<u>.01</u>	<u>.01</u>	—	<u>.05</u>	.01	.01	

NS – Not significant
.05 – significant at .05 level
.01 – significant at .01 level
See text for explanation of underlining.

gories concerned with stoplight phase and presence of opposing traffic had the lowest inter-observer agreement.

Frequency of turn-signalling determined under conditions designed to eliminate the possibility of the drivers noting the presence of the observers did not differ significantly from the frequencies obtained with observers in their usual observation positions.

RESULTS

The data gathered from the field observations were analyzed to determine the effects of type of intersection, sex of driver, direction of turn, presence of preceding and/or following traffic, turn-signalling of a preceding car, opposing traffic, and arrival at an intersection on the red or green-yellow phase on the turn-signalling of passenger cars.

Table 1 gives the number of cars signalling or non-signalling, the percent of turning cars signalling and the total number of turning cars for both male and female drivers turning left or right at the various observation sites. The small number of female drivers at some of the sites would suggest caution in comparisons involving female turn-signalling frequency at these sites.

Type of Intersection

Table 2 presents the results of Chi-square tests of comparisons of male turn-signalling frequency for the different sites. (Male frequencies are used because of greater confidence in the stability of the male results.) Significance figures given above the diagonal refer to comparisons for right turns; significance figures given below the diagonal refer to comparisons for left turns. Significance figures are underlined when the male turn-signalling frequency was higher at the site named in the column heading than at the site named in the row heading. Inspection of the table reveals that virtually every site differs significantly from every other site in turn-signalling frequency for both right turns and left turns.

The highest male signalling frequency was obtained for left turns at Site 3 (86 percent). This site was at a stoplight intersection in a semi-rural area. The turns were made from an undivided four-lane highway and the speed limit was in the highest category of all sites studied. The lowest male signalling frequency was obtained for right turns at Site 1-A (25 percent). This site is one of the legs of a secondary road at a two-way stop near the center of the campus with probably the lowest average speed of all the sites studied.

The lowest male signalling frequency for left turns was also found at Site 1-A.

The highest male right-turn signalling occurred at Site 2-B although the frequencies obtained at Site 4 and 6-A are not significantly different. Right turns at 2-B involved turning off a primary road at a two-way stop where speeds on the primary road were often somewhat in excess of the posted 25 mph. Right turns at Site 4 and 6-A, respectively, involved turning off a six-lane divided avenue and turning off a four-lane divided expressway-type road (both roads carrying U.S. highway traffic).

Site 6-B did not differ significantly in male right-turn signalling from Site 1-A, the site with the lowest percent signalling, although the difference was quite close to significance. Site 6-B involved turning off a specially widened two-lane street with a special marked right turn lane.

Site 6-A which is similar to the site possessing the highest left-turn signalling frequency (Site 3) with respect to average speed of traffic and traffic volume but which had a special left-turn lane and a signal phase for left turns only was significantly lower in male left-turn signalling than all other sites except 1-A, 1-B and 2-A and was not significantly different from Sites 1-B or 2-A. Site 7 was equivalent to Site 6-A in almost all respects but lacked the special left-turn lane. Male left-turn signalling is significantly higher at Site 7 than Site 6-A but all other statistical comparisons are the same as that of Site 6-A.

Other comparisons can be made by the reader using Tables 1 and 2 and the site descriptions in combination. The conclusion can be readily drawn that turn-signalling behavior appears to be quite sensitively related to intersection and road characteristics. The determination of relative importance of various intersection characteristics requires further study. The data tends to suggest that higher speeds at the intersection increased turn-signalling frequency and that special turning lanes and special turning phases of the stoplight sequence reduced turn-signalling frequency. It would also appear that a left turn lane is less important for reducing turn-signalling frequency than a special stoplight phase for left turns.

Time of Day and Related Factors

An objection that might be raised is that the obtained differences in turn-signalling between sites reflected characteristics related to time of day, time of year and different groups of drivers rather than intersection characteristics *per se*. Such an objection can not be unequivocally excluded but a number of check observations provide no support whatsoever for this interpretation of the results.

TABLE 3

STATISTICAL COMPARISONS OF MALE VS. FEMALE TURN-SIGNAL FREQUENCY

Site	Right Turns	Left Turns
1-A	NS	.01
1-B	NS	NS
2-A	NS	.01
2-B	ID	NS
3		NS
4	.01	
5	.01	NS
6-A	NS	.01
6-B	.01	NS
7	NS	NS

ID – Insufficient data for statistical test; See Table 2 for code.

Initial observations at Site 1-A were made in the early afternoon hours. Check observations were made during the late morning hours on a subsequent set of days. No statistical differences were found in turn-signalling frequency. Three months after the initial observations an additional set of check observations were obtained. The initial observations were made in the summer by two observers who recorded different details on the same car; the fall observations were made by a different single observer. Volume had increased from about 100 vehicles per hour to about 160 per hour and, on one day of the fall observations, construction work which blocked a neighboring road diverted new traffic through the intersection. Not only were the signalling frequencies not significantly different but the percentages obtained were quite similar.

Other observations were made to determine the effect of volume and time of day with similar results. (It should be noted that a change in volume at a given intersection can usually not be obtained without also varying time of day although a change in time of day can often be made without change in volume.)

Observations were made at Site 1-B during early afternoon hours and during the late afternoon rush period. Volume increased from about 130 cars per hour to 230 cars per hour. Turn-signalling frequencies were not significantly different.

No significant differences were found in comparing noon hour traffic with morning rush traffic at Site 4 or in comparing early afternoon with late afternoon rush hours at Sites 6-A, 6-B and 7. This lack of difference is especially interesting in view of the fact that most of the early afternoon and late afternoon observations were made on different days for the last named sites.

It is also worth noting that in all cases where legs at right angles to each other at an intersection were studied, significant differences were found for male signalling frequency for both right and left turns between these legs but no significant differences were found between opposing legs.

The pattern of these checks is consistent in providing no evidence for the influence of time of day (and its associated volume) on turn-signalling frequency at the sites studied. The consistency of the results obtained at Site 1-A suggests that time of year (within the period studied) was not a significant factor. It is possible that these intersections differed markedly in the type of driver passing through these intersections. However, many of these sites were quite close together and would be expected to carry much the same population of drivers not only because of their geographical proximity but also because they were associated links in local transportation routes. Also, the data shows that different legs at an intersection do not differ in turn-signalling frequency when they are similarly constructed (all opposing legs studied were) but they do differ significantly when they are differently constructed.

Sex of Driver

Table 3 presents the results of statistical comparisons of male and female drivers for right turns and left turns at the various observation sites. The results may be summarized as showing that female drivers signalled significantly more than males or they did not differ significantly. They never signalled significantly less. The comparison was not made for right turns at Site 2-B because of insufficient data. (Chi square tests were not made in this study when any cell of the table had a theoretical frequency of less than five or when any two cells each had a theoretical frequency of less than ten.)

Direction of Turn

Table 4 presents the results of statistical comparisons of signalling frequencies for left vs. right turns for both males and females. The results for both males and females are consistent in showing that left turns were signalled significantly more than right turns or they were not significantly different. Right turns were never signalled at a significantly higher frequency than turns.

TABLE 4

STATISTICAL COMPARISONS OF RIGHT VS. LEFT TURN-SIGNALLING FREQUENCY

Site	Males	Females
1-A	.01[a]	.01
1-B	.01	NS
2-A	.01	.01
2-B	.01	ID
5	.01	NS
6-A	NS	NS
6-B	.01	.01
7	NS	NS

[a]See previous tables for code.

Presence of Preceding or Following Car

The effect of a car preceding the observed car by 100 ft or less of a car following the observed car by 100 ft or less and of the various combinations of these circumstances on the signalling frequency of the observed driver was also studied. Data from several sites were combined so as to provide an adequate number of cases for statistical analysis of female drivers and to provide different levels of turn-signalling.

Right turns at Sites 1-A and 2-A were combined. Right turns at 1-B, 2-B and 4 were also combined. Left turns at 1-A and 2-A were combined. Left turns at 1-B, 2-B and 3 were also combined. The grouping yielded two levels of turn-signalling for right turns (low and medium) and two levels for left turns (medium and high). There were no sites with a high signalling level on right turns or a low level on left turns.

Each of the four combinations of direction of turn and signalling level was analyzed for male and female drivers separately. No statistical differences were found in any of the following comparisons: (a) car ahead vs. no car ahead when there was no car behind; (b) car ahead vs. no car ahead when there was a car behind; (c) car behind vs. no car behind when there was no car ahead; and (d) car behind vs. no car behind when there was a car ahead. Similar results were found in analyzing the effect of a following car on male drivers only at sites 6-A, 6-B and 7.

In considering the negative nature of these findings, especially in relation to following traffic, it is important to keep in mind the manner in which the data were analyzed. There were only two categories with respect to a car ahead (within 100 ft or not within 100 ft). Likewise, there were only two categories with respect to a car behind (within 100 ft or not within 100 ft). Thus, both a car with another car behind it 101 ft and a car with no car behind it within sight would fall in the same category in the analysis, i.e., observed car has no car behind. It is possible that our drivers were responding to cars at further distances than 100 ft. The analysis is based on the assumption that in many cases there was no car in sight and that the closer the following car was the greater would be its effect. Further research is planned with more categories of following distances. The present data strongly suggests that turn-signalling behavior was not influenced by the presence of cars behind the turning car.

Signalling Behavior of Preceding Car

Pairs of cars were selected from the field records using the following criteria: (a) both cars turned at the site under study; (b) the following car was 100 ft or less behind the lead car when the lead car began its turn; and (c) no cars were in the same lane between the two turning cars. Sites were grouped in the same manner as in the comparisons for the effect of preceding and following car. The direction of turn and the sex of the driver of the following car determined the classification for the combination of driver sex and direction of turn. All comparisons failed to reach the .05 level of significance.

Opposing Traffic

The effect of opposing traffic within 100 ft of the intersection was also studied. No comparisons could be made for Sites 4, 6-A or 7 because the nature of these sites made the presence of opposing traffic irrevelant to the turning movement. The presence of opposing traffic significantly increased male left-turn signalling at Site 1-B (.01 level) and at Sites 2-A and 3 (.05 level), male right turn signalling at Site 2-A (.01 level) and female right-turn signalling at Site 2-A (.05 level). All other comparisons failed to reach the .05 level of significance or were not tested because of insufficient data (male right turns, Site 6-B; female right turns, Sites 1-A, 2-B, 5 and 6-B; female left turns, Sites 2-A and 6-B).

Stoplight Phase

Another situational characteristic that appeared likely to be related to turn-signalling was the phase of the stoplight when the vehicle reached the intersection. If it is red, the driver must stop before beginning the turning movement. If the signal is green or yellow, he can often attempt the turn without stopping and, in some circumstances, without changing speed. The data obtained at Sites 3, 4, 5 and 6-B and for right turns at 6-A were examined for the effect of stoplight phase. Males signalled significantly more for right turns (.05 level) at Site 4 when reaching the intersection on the green-yellow phase. Females signalled significantly more for left turns (.05 level) at Site 3 when reaching the intersection on the red phase. All other comparisons were not significant. The inconsistent nature of the findings and the fact that the signal phase category had the lowest reliability of any category suggest that these results are due to chance.

Type of Signal

Virtually all turn signals observed during the course of this study were made by means of electric turn signals. The highest percent of hand signals (6.5 percent) was obtained at Site 3, the site with the highest signalling percentage. Since there was such a widespread dependence on electric turn signals, it was thought advisable to obtain an estimate of the percent of cars in the area so equipped.

One hundred cars were sampled from each of six large parking areas on the campus by taking all cars in sequence from the entrance to the parking area. These areas were used by university staff and students and by visitors. Each car was inspected for a turn signal lever. The percent of cars equipped with electric turn signals did not differ significantly from parking area to parking area and averaged 85 percent. This percent was significantly different (.05 level) from the percent of cars using electric turn signals at Site 3.

It would appear then that under some circumstances virtually all cars with electric turn signals (93 percent) will use them. It would also appear that more than half of the drivers in cars without electric turn signals will not signal for a turn even in good weather during the summer and under circumstances that would cause almost all drivers in cars equipped with electric turn signals to signal.

On first impression it might seem that equipping a passenger car with electric turn signals increases the frequency of turn-signalling. However, another hypothesis is quite tenable: namely, most of the drivers of passenger cars which are not equipped with electric turn signals are not interested in signalling for turns. The two hypotheses are not mutually exclusive and will require additional study for their resolution.

DISCUSSION

The results of this exploratory investigation justify the use of turn-signalling behavior as an instance of driver behavior worthy of intensive study. The behavior could be measured in a reliable way and was found to be related to a number of situational characteristics (such as type of intersection and direction of turn) and to be unrelated to other situational characteristics (such as the presence of a following car and the signalling behavior of a preceding car) in ways that are not trivial or obvious. Additional research will be required to isolate significant intersection features and to determine the extent to which various situational factors interact. Research is also needed on the influence of individual characteristics in addition to those of sex.