Driver Knowledge of Grade-Crossing Information

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Questionnaires were completed by 829 licensed drivers or candidates for licenses in an effort to ascertain their level of knowledge concerning highway-railroad grade-crossing information. Questions were asked concerning traffic-control devices, facts relating to grade-crossing hazards, and driver responsibilities at grade crossings. Respondents were stratified by age and elements of training and/or experience. Major findings of the study include the following: (a) Collection of interview data at a driver's-license examining station is an effective method of determining driver knowledge, (b) more than 50 percent of all respondents believed that all grade crossings except those rarely used by trains have active warning signals, (c) most drivers have adequate knowledge concerning the hazards of grade crossings, (d) most drivers do not know the required driver response at passive grade crossings, (e) drivers perceive little law enforcement related to driver actions at grade crossings, and (f) driver knowledge and/or understanding of the traffic-control devices used to warn of grade crossings is inadequate. Recommendations are made regarding driver knowledge items that should be considered for inclusion in public information campaigns on grade-crossing safety. Future research regarding different advance warning signing for active and passive crossings and enforcement as a countermeasure is also recommended.

When traffic engineers call for traffic-control devices to be erected, it is always with the intent that the driver understand the message conveyed. Enforcement officials must assume that drivers understand their responsibilities. Nowhere are these two assumptions more critical to safety than at the intersection of a roadway with a railroad, hereafter referred to as a grade crossing. Assumptions concerning driver knowledge of grade-crossing information have been investigated by Sanders (1) and Dommasch and others (2). Their investigations included the administration of questionnaires at grade crossings. Due to the need to minimize delay to motorists, the subject areas addressed by these questionnaires were limited. These studies dealt primarily with facts concerning the crossing the driver had just negotiated. This research attempts to infer the level of driver knowledge of grade-crossing information from data obtained in a more controlled environment.

During the summer of 1979, drivers arriving at a Tennessee Department of Safety driver's-license examining station were administered a questionnaire to determine their level of knowledge concerning highway-railroad grade crossings, facts relating to grade-crossing hazard, and driver responsibilities at grade crossings. Demographic information and data on driver exposure to various efforts to educate drivers about grade crossings were also obtained.

METHODOLOGY

One driver's-license examining station operated by the Tennessee Department of Safety was selected for the interview site. The researchers consider that this site is reasonably representative of examining stations in urbanized areas. The sampling plan required that 400 responses be randomly obtained. This would allow 95 percent confidence that the aggregated responses were within 5 percent of the true knowledge level of the universe of drivers arriving at this examining station.

The questionnaire used to obtain the data on driver knowledge is shown in Figure 1 (asterisks have been added to indicate the correct responses). It should be noted that data were obtained from both drivers coming to obtain a license and escort drivers (or others) who accompanied the license candidates. Drivers were advised that this questionnaire was for research purposes only and would not affect the licensing procedure.

CONDUCT OF STUDY

The driver's-license examining station for the Knoxville, Tennessee, area was selected for the interviews. Data were collected during a one-week period in June 1979. During this period, all drivers coming to the station were asked to participate in the study. Only licensed drivers or those expecting to be licensed as a result of testing on the day of the interview were given questionnaires. A total of 1011 drivers were contacted during this period. Completed questionnaires were obtained from 829 drivers, for a response rate of 82 percent. All completed forms were returned before the respondent left the interview station.

The responses were separated into groups for analysis to determine whether there were significant differences in responses among the groups. Groupings were made and analysis was performed for each of the following stratifications:

1. Drivers who recalled grade-crossing instructions from safety campaigns (174) versus those who did not recall instructions from that source (655),
2. Drivers who recalled grade-crossing instructions from driver training courses (290) versus those who did not recall instructions from that source (539),
3. Drivers who recalled grade-crossing instructions from the driver's handbook (547) versus those who did not recall instructions from that source (282),
4. Drivers who recalled instructions from other sources (99) versus those who did not recall instructions from those other sources (730),
5. Male drivers (414) versus female drivers (415),
6. Drivers who came to the examining station prepared to take a written driver's test (257) versus those who were not prepared (escort drivers or friends of candidates) (572),
7. Drivers who had reviewed the driver's handbook within the past two weeks (191) versus those who had not reviewed the handbook (638),
8. Drivers who had completed a driver education course within the past year (75) versus those who had not completed a course (754), and
9. Five age groups: under 25 (340), 25-34 (216), 35-44 (165), 45-59 (83), and over 59 (25).

The responses from each of the nine groups were analyzed by using the chi-square test and a 95 percent confidence level. This analysis was made to determine whether or not the responses to the individual questions differed significantly among the groups.

RESULTS

The overall responses for all of the 829 drivers are shown in Figure 1 in the form of percentages adjacent to each of the possible responses for each question. These percentages indicate the proportion of the 829 drivers who indicated that the associated response was the correct answer to the question.

All of the stratifications were subjected to a

Figure 1. Questionnaire used to determine driver knowledge of grade-crossing information.

Asterisks have been added to indicate correct answers. The overall responses (percentages) are indicated in the circles.

Your answers to the following questions will be used in a research project which is attempting to find a way to improve highway safety.

We need to have all questions answered, so please answer to the best of your present knowledge. Thank you for your assistance.

1. Do you recall specific instructions concerning driving safety at railroad crossings from any of the following sources? Check only those you remember something from.

   Safety Campaign (Radio, TV, etc.) (21)% Tennessee Driver's Handbook (66)%

   Driver's Education Course (35)% Don't recall any instructions (12)%

   Other (7)% _____ specify

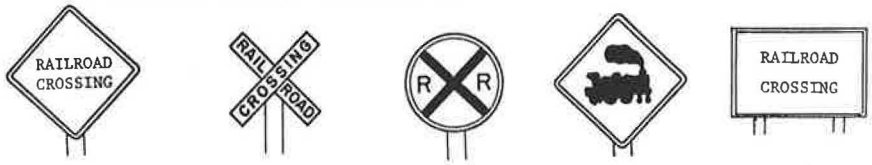
2. Which of the following is actually placed just at the point where the railroad tracks cross the highway? Check only one.

   (0.3) % (21) % (71) %* (2) % (0.1) %

3. Are you male or female?

   Male (50) % Female (50) %

4. Which of the following is usually located several hundred feet in advance of a railroad crossing? Check only one.



   (19) % (15) % (62) %* (1) % (0.1) %

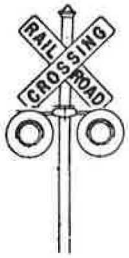
5. What does it mean when this railroad signal is flashing? Check only one.

   You are approaching a crossing (2)% This is a warning to the train engineer (0.2) %

   Slow down for rough crossing (0.1) % Don't know (0.2) %

   A train is coming (97) %*

6. At which railroad crossings is this railroad signal usually placed? Check only one.



   All railroad crossings (35) % Only the most dangerous crossings (27) %*

   All except the ones rarely used by trains (19) % Crossings with more than one track (13) %

   Crossings where there have been fatal accidents (4) %

7. How long does it generally take for a train to reach the crossing after the railroad signal begins to flash? Check only one.

   A flashing signal has nothing to do with a train coming (4) %

   0 - 10 seconds (7) %

   10 - 30 seconds (22) %

   30 - 60 seconds (37) %

   Over 1 minute (30) %

8. In general, how does the distance needed to stop a train compare with that needed to stop a large truck traveling at the same speed? Check only one.

   Same (2) % Train needs more distance to stop (93) %*

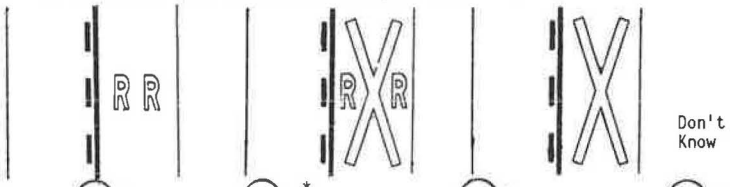
   Truck needs more distance to stop (4) %

Figure 1. Continued.

9. What does this sign mean? Check only one.

Slow down to 20 miles per hour (mph) due to rough crossing	24 %	Slow down to 20 mph and look for a train	72 %*
The trains that use this crossing travel at 20 mph	3 %	Drive faster than 20 mph to cross safely.	0.6 %

10. Which of the following are the standard marking painted on the pavement in advance of most railroad crossings? Check only one.



7 % 70 %* 5 % Don't Know 18 %

11. What should you do when approaching a crossing that does not have a railroad signal? Check only one.

Not applicable, since all crossings have railroad signals	3 %
Maintain speed, but be ready to stop if you see or hear a train	2 %
Slow down and be ready to stop if you hear or see a train	38 %*
Speed up and cross the tracks quickly to avoid an accident	0.7 %
Stop at the crossing and look for a train	56 %

12. What should you do when approaching a crossing that has a railroad signal? Check only one

Slow down, look to see if the signal is flashing and look for a train	43 %
Slow down and be ready to stop if you hear or see a train	16 %
Slow down and look to see if the signal is flashing	11 %*
Maintain speed, but be ready to stop if you see or hear a train	3 %
Stop at the crossing and look for a train	26 %

13. Approximately how many motorists were killed in accidents at railroad crossings last year in the United States? Check only one.

10	2 %	10,000	38 %
100	13 %	100,000	5 %
1,000	40 %*		

14. **What should you do when approaching a railroad signal that is flashing? Check only one.**

Slow down and look for a train	7 %
Stop at the crossing and wait for the signal to quit flashing unless after stopping you are positive that no train is approaching	81 %*
Maintain speed and go through the crossing unless a train is already there	1 %
Stop at the crossing and wait for the train to cross unless it appears you can cross before the train arrives	11 %
No action required, since this signal just alerts you to the crossing	0.3 %

15. What is you age?

Under 25 (41) % 25-34 (26) % 35-44 (20) % 45-59 (10) %
Over 59 (3) %

16. Are you satisfied with the current signs, signals, and pavement markings used at railroad crossings? If not what additional traffic related measures would you like to see taken to improve safety at railroad crossings?

Present system satisfactory	49 %
Other measures needed	50 %

29%
Specify

Figure 1. Continued.

		YES	NO
17.	Are you at the Driver Examining Station to take a test?	31 %	69 %
18.	Have you reviewed the Tennessee Driver's Handbook in the last two weeks?	23 %	77 %
19.	Have you or someone you know ever received a traffic citation (ticket) for improper driving at a railroad crossing?	4 %	96 %
20.	Have you completed a Driver's Education course within the past year?	9 %	91 %
21.	Are you licensed to drive (other than just a driver's permit) in Tennessee or some other state?	84 %	16 %

If you received this questionnaire at a Driver Examining Station, please wait to complete the last question until you have finished all tests. Thank you.

chi-square analysis ($\alpha = 0.05$) by forming contingency tables. The independent variable in the table was the group the respondent fell into (age, sex, etc.). The dependent variable was whether or not the respondent answered the question correctly. This was done for all of the nine stratifications. Each of the 11 gradable questions was analyzed in this manner. This analysis indicated that there were several groups that had significantly different knowledge concerning specific questions.

When compared with the group that did not recall instructions on grade-crossing safety from a safety campaign, the group that did recall such instructions gave a significantly higher proportion of correct answers to questions 4, 10, and 14. This means that those who recalled instructions on grade-crossing safety knew more about the advance-warning sign, pavement markings, and driver responsibility at a flashing railroad signal. The type of campaign the drivers were exposed to was not identified. However, this finding suggests that the campaigns these drivers were exposed to may have contributed to their greater knowledge in these three areas.

When compared with the group who came to the station not expecting to be tested, the group that was expecting to be tested gave a significantly higher proportion of correct answers to questions 9 and 11. This means that the drivers who expected to be tested were more knowledgeable concerning the meaning of an advisory speed sign used with an advance-warning sign and the driver's responsibility at a passive crossing. However, the drivers who were expecting to be tested gave a significantly lower proportion of correct answers to question 6 (extent of active protection). This indicates that the materials and reviews that drivers are exposed to in preparing for testing are (apparently) significantly helpful in the two areas addressed by questions 9 and 11.

When compared with the group who had not reviewed the driver's handbook in the past two weeks, the group who had reviewed the handbook gave a significantly lower proportion of correct answers to questions 6 and 13. This means that those who had reviewed the handbook were less knowledgeable concerning the extent of active protection at crossings and annual grade-crossing fatalities.

When compared with the group that had not completed a driver education course within the past year, the group that had completed a course gave a significantly lower proportion of correct answers to questions 6 and 14. Thus, drivers who had taken a driver education course within the past year were less knowledgeable concerning the extent of active protection and driver responsibility at a flashing railroad signal. Researchers had expected the group that had attended a driver education course to perform significantly better. The fact that they did not may indicate the lack of coverage that is given to grade-crossing-related matters in driver education courses.

The significantly poorer performance on certain questions by the drivers who came expecting to be tested, who had reviewed the driver's manual, or who had recently completed a driver education course may be attributable to the fact that they were probably less experienced drivers than the escort drivers.

When compared with women, men gave a significantly greater proportion of correct answers to questions 6, 10, and 11. This means that men have significantly greater knowledge concerning the extent of active protection, pavement markings, and driver responsibility at passive crossings.

When the different age groups were examined, it was found that drivers under age 25 gave a significantly lower proportion of correct answers to questions 6 and 14. This indicates that young drivers are less knowledgeable concerning the extent of active crossings and driver responsibility at a flashing railroad signal. Here again, driving experience may be the important variable. Drivers in the 25-34 age group answered question 11 with a significantly higher proportion of correct answers. This indicates that the 25- to 34-year-old driver knows more about driver responsibility at passive crossings. These findings may be the result of the younger drivers' lack of exposure to grade crossings. Because the 25- to 34-year-old drivers have had more exposure to grade crossings, their knowledge in the area of question 11 is greater.

The sample was also compared with the population of licensed Tennessee drivers. The male-female ratio of the sample was compared with that of licensed Tennessee drivers by using chi-square analysis. This analysis indicated that there was no significant difference in the male-female ratio ($\lambda^2 = 2.384$, df = 1; $\lambda^2_{0.05,1} = 3.841$).

The age distribution of the sample was compared with that of licensed Tennessee drivers. The Tennessee drivers were aggregated into the same five age groups established in the questionnaire. A chi-square analysis of the age distribution of the sample and the Tennessee drivers indicated that the age distribution was significantly different ($\lambda^2 = 251.689$, df = 4; $\lambda^2_{0.05,4} = 9.488$). The sample was skewed toward younger drivers, which is to be expected because the driver's-license testing system is oriented toward testing younger drivers and because younger age groups are more mobile in our society. This difference should be considered when the results of this research are applied.

CONCLUSIONS

1. Data collection at a driver's-license examining station is a good method for obtaining information on driver knowledge. Drivers are conditioned for testing in that environment and are generally cooperative.

2. A total of 35 percent of the drivers tested indicated that all grade crossings have active protection; another 19 percent indicated that all grade crossings except those rarely used by trains have active protection. It can therefore be concluded that drivers' knowledge of these matters at the Knoxville driver's-license examining station was very inadequate (only 27 percent answered correctly). These responses indicate that 54 percent of the drivers contacted believe that, if a crossing does not have a signal, it is rarely used by trains. This may affect the driving behavior of those drivers as they approach passive crossings. Drivers who believe that signals are placed at all crossings that are regularly used by trains would logically be expected to drive as if they had the right-of-way unless they see a flashing signal or a lowered gate. However, this hypothesis would have to be tested by further research. It should also be noted that drivers who had reviewed the driver's handbook, were prepared to take a test, or had completed a driver training course in the past year actually did worse in this area.

3. Driver responses to the questions concerning the number of grade-crossing fatalities and relative stopping distance for trains indicate that drivers have adequate knowledge concerning these two measures of the hazards of highway-railroad grade crossings. Of course, the lack of knowledge concerning the extent of active protection indicates a great lack of knowledge of the true hazard at grade crossings.

4. An unusually high proportion of drivers (56 percent) indicated that they should always stop at passive grade crossings, and 26 percent indicated that they should stop at active crossings. This indicates that these drivers believe that more is required of them than actually is required. To use a marketing analogy, the customer (driver) may perceive that the price is too high for the product (safety) and therefore refuses to purchase the product. If drivers know that a cautious approach to a passive crossing, not a mandatory stop, is the actual requirement, they may be willing to pay that price. In other words, if drivers know that a legal requirement that is less restrictive than a stop is in effect, they may be willing to obey the lesser requirement. Future research would be needed to test this hypothesis.

5. Only 4 percent of the drivers were aware of an enforcement action relating to grade crossings. This indicates that enforcement as a countermeasure may produce benefits, since for all practical purposes it is not currently perceived as being used as a countermeasure.

6. A substantial portion of the drivers (±30 percent) could not correctly answer questions 2, 4, 9, and 10, which relate to traffic-control devices. This indicates a deficient knowledge and/or understanding of the commonly used uniform warning devices.

7. Forty-three percent of the drivers indicated that when approaching an active crossing they should look for trains as well as look at the signal. Here again, drivers may perceive that an unreasonable requirement is placed on them and simply opt to do nothing. Drivers should be advised that as they approach an active grade crossing they should carefully examine the signal to see whether it is activated. Apparently, many drivers do not place complete confidence in active protection.

RECOMMENDATIONS

To the extent that one is willing to apply the results of this effort to the entire universe of drivers, the following recommendations appear to merit consideration:

1. In the development of educational efforts such as driver training courses, driver's handbooks, and public safety campaigns, to improve safety at grade crossings the following should be clearly conveyed: (a) Only the more hazardous crossings have active protection; (b) standard traffic-control devices should be described and their placement discussed; (c) drivers are required to slow down, look, and listen for trains at passive crossings, and a stop is not required except for certain vehicles or at crossings where public authorities have erected a standard stop sign; (d) drivers are required to always examine railroad signals to determine whether they are flashing before traversing the crossing, and a stop is not required unless the signal is activated; and (e) knowledge concerning the hazards of grade crossings is apparently adequate and does not need to be overly emphasized in an education effort.

2. Consideration should be given to developing unique advance signing to inform drivers that they are approaching a passive crossing. Currently, advance signing and pavement marking are the same for both active and passive crossings even though vastly different driving behavior is desired at the two types of grade crossings. Drivers approaching passive crossings are expected to slow down, look, and listen for trains; when approaching active crossings, they are expected to maintain their speed and carefully observe the signal. This study revealed the low level of knowledge concerning which crossings have active protection.

3. Enforcement as a countermeasure should be evaluated as part of a future research effort, since it is not being perceived as a countermeasure at this time.

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