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**Analyses of Drivers' Responses to In-Vehicle Receiver
(IVR) after Experiencing One Mode of Operation**

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A study Report for:

The Pilot Study of Advisory On-Board Vehicle Warning Systems
at Railroad Grade Crossings

A study conducted by:

Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign

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16. Abstract Survey Number 2 (out of four surveys) was conducted three months after the IVR system was operational. During the period, the participating drivers received only one type of message from their IVRs, either an audible or a visual message. The audible and visual groups gave similar effectiveness ratings for all warning devices except the clanging bell. The visual group rated the clanging bell higher than the audible group. The IVR average effectiveness rating from the audible group was 3.3 and from the visual group it was 3.4 using a 5.0 scale. The effectiveness of the IVR was similar to the crossbuck and advance warning signs, but lower than the crossing gate, flashing lights, clanging bell, and the train horn. The audible and visual groups trusted the IVR to the same degree. About 60.6% of the audible group and 58.4% of the visual group trusted the IVR to give an accurate warning of a train approaching/occupying the equipped crossings. The drivers in general were satisfied with the quality of the message from their IVR. For the visual mode, 51.6% of the drivers rated the overall quality of the message as good or excellent, 26.7% as fair, 15.0% said it was poor, and 6.7% had no opinion or did not respond. For the audible mode, 52.5% rated the overall quality of the audible message excellent or good, 14.6% as fair, 15.9% said it was poor, and 17% did not have an opinion or did not respond. A small percentage (14-16%) of drivers in the audible group said either the tone was too loud, too harsh or piercing, or it beeped for too long.			
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The contents of this report reflect the views of the authors who were responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Illinois Department of Transportation. This report does not constitute a standard, specification, or regulation.

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INTRODUCTION

This report analyzes driver perceptions and understanding of the advisory on-board warning information after using the system for approximately three months. The Pilot Study of Advisory On-Board Vehicle Warning Systems at Railroad Grade Crossings sought to provide the equipped roadway vehicles approaching selected railroad grade crossings with an on-board/advisory warning of a train approaching or occupying the grade crossing. System performance details are given in a separate report (see reference 1). The system design was composed of a trackside transmitter assembly (TTA) and the in-vehicle receiver (IVR). The TTA sent a K-band signal to the IVR when a train was approaching or occupying the crossing. The TTA was installed at five railroad grade crossings equipped with a combination of flashers and gates along the Metra-Milwaukee North line (in the Chicago metropolitan area). The grade crossings handle Amtrak and freight train movements in addition to significant Metra commuter train movements. There are between 70 and 115 total train movements per crossing on a typical weekday.

The location, jurisdiction and characteristics of the sites in the pilot study were as follows:

- 1- Beckwith Road/Lehigh Avenue, Morton Grove: Residential Area
- 2- Chestnut Street/Lehigh Avenue, Glenview: Industrial Area
- 3- Shermer Road, Northbrook: Commercial Business District Area
- 4- Dundee Road, Northbrook: Major High Speed Arterial
- 5- Greenwood Avenue/Chestnut and Park, Deerfield: Residential Area

Approximately 300 IVR units were installed in the vehicles of participating organizations. These organizations were chosen based on their proximity to the study area and number of movements over the five designated crossings. A mix of public and private organizations participated in the pilot study. Private sector firms were selected by contacting the local chambers of commerce. The selection of school bus companies was based on information provided by the Illinois Department of Transportation (IDOT) Division of Traffic Safety. Local governmental agencies for each of the pilot study area communities agreed to participate. A total of thirty-eight organizations participated in the pilot study.

A human factors study was conducted in order to determine the ideal placement and optimal mounting technique for installing the IVR. Since the vehicle types differed among the participating organizations, on-site vehicle fleet evaluations were conducted to determine specific installation requirements. Installation recommendations for each vehicle type were determined according to the dashboard configuration, the driver's field of vision constraints, vehicle vibration considerations and fleet equipment restrictions. The IVR was placed within the driver's cone of vision as recommended in the human factors study and on-site vehicle evaluations.

Surveys were utilized to document drivers' perceptions of the advisory warning system. Their perceptions represent the foundation of the evaluation effort. The final evaluation is based on four surveys distributed during the pilot study. These surveys included: the base line survey distributed prior to deployment and three surveys distributed during the course of the pilot study. The baseline survey sought background information from the drivers such as their age, work experience and perception of existing railroad crossing devices (2). The other three surveys were directly related to the drivers' experience with the advisory warning system (3, 4).

Survey Number 2 was conducted three months after the IVR system was deployed. During the three month period, the participating drivers received only one type of message from their IVRs, either an audible or a visual message. A copy of Survey Number 2 is given in Appendix A.

Survey Number 2 is composed of a comparison between two IVR modes, audible and visual. A total of 328 drivers participated in the survey, 141 used the audible and 187 used the visual mode. Surveys from drivers who had less than one month or more than nine months of driving experience with an IVR-equipped vehicle were not used in this analysis. Surveys from drivers who did not cross any of the five railroad crossings (drivers who confirmed that they did not cross or those who did not respond to this question) were not used. The reasons for deleting these surveys was that the drivers with less than one month experience with the IVR device, or those who did not cross any of the crossings, did not have adequate experience with the IVR system. A few drivers who stated that they had experience of driving a vehicle with an IVR for greater than nine months in the year 2000 clearly did not understand the question well, so their responses

were not considered in the analysis. The remaining 82 audible and 120 visual surveys were analyzed and their results are reported in this section. The audible and visual responses are presented together unless there was a statistically significant difference between the responses of the two groups. When the difference was significant, the results are reported for each group separately.

STATISTICAL ANALYSES

In the Year 2000, How Long Have You Driven a Vehicle with the In - Vehicle Receiver (Q1)?

The total number of drivers who responded to this question was 202, out of that 82 were in the audible and 120 in the visual mode. The distribution of the number of months that the participants had the IVR is given in Figure 1.

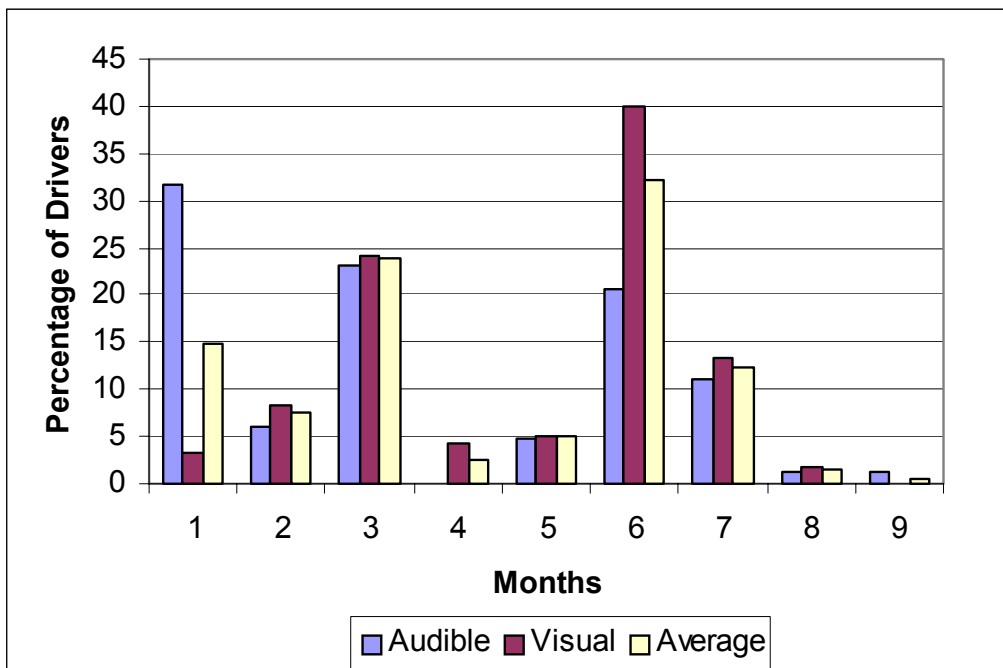


Figure 1: In the year 2000, how long have you driven a vehicle with the IVR?

On the average they drove an IVR equipped vehicle for 4.3 months. The average number of months the drivers had the IVR was 3.59 months for audible and 4.80 months for visual. The responses for the average number of months that the drivers had the IVR were significantly different for the visual and the audible mode. Approximately 31.7% of the drivers had the IVR in the audible mode for one month, compared to 3.3% for the drivers with the IVR in the visual mode. For both modes, more than 90% of the drivers had the IVR for a period of up to seven months.

Do You Use Any of the Following Railroad Crossings (Q2)?

The responses to this question came from 202 drivers who used at least one of the crossings. The participants were asked to state the frequency of usage of the five grade crossings. The percentages of drivers who used each of the crossings are given in Table 1. The crossing used by the highest number of participants was Chestnut Street (51.0%), followed by Shermer Road (40.6%), Dundee Road (39.6%), and Beckwith Road (21.3%). The crossing used by the least number of the participants was the Greenwood Avenue crossing, where only 13.4% of the drivers traversed it. The percentages of drivers who did not use at least one of the crossings varied from 0.0% to 0.5%. A large portion of the respondents (48.5%-86.1%) did not answer this question. The driver uncertainty for determining if they crossed a particular site could be based upon the study being in an early phase. Surveys 3 and 4 (conducted after six and nine months of deployment) have a much higher percentage of “no” answers.

Not all the participants used all the crossings. About 4.0% of the drivers used all five crossings, 8.0% used only four, 17.4% used only three, and 36.7% used only two out of the five crossings. Thus, about 66.1% of the drivers used at least two of the crossings, 29.4% used at least three of the crossings, and 12.0% used at least four of the crossings. Table 2 presents the percentage of participants that used the crossings.

Table 1: Percentage of drivers that used railroad grade crossings in the study area				
Jurisdiction	Crossing	No (%)	Yes (%)	No Response (%)
Morton Grove	Beckwith Road	0.5	21.3	78.2
Glenview	Chestnut Street	0.5	51.0	48.5
Northbrook	Shermer Road	0.0	40.6	59.4
Northbrook	Dundee Road	0.0	39.6	60.4
Deerfield	Greenwood Ave.	0.5	13.4	86.1

Table 2: Number and percentage of drivers who used the crossings in the study area					
	Drivers who crossed				
	All 5 crossings	Only 4	Only 3	Only 2	At least 1
Frequency	8	16	35	74	202
Percentage	4.0%	8.0%	17.4%	36.7%	100.0%

Beckwith Road in Morton Grove: A total of 43 drivers reported using the Beckwith Road crossing. Figure 2 shows the frequency of usage of the crossing by the drivers. On the average, the drivers used this location 4.9 times per week. The percentage of the drivers who used this crossing up to two times per week was 48.8%. About 90.7% of the drivers used this location up to 10 times per week. The maximum usage reported for this crossing was 30 times per week.

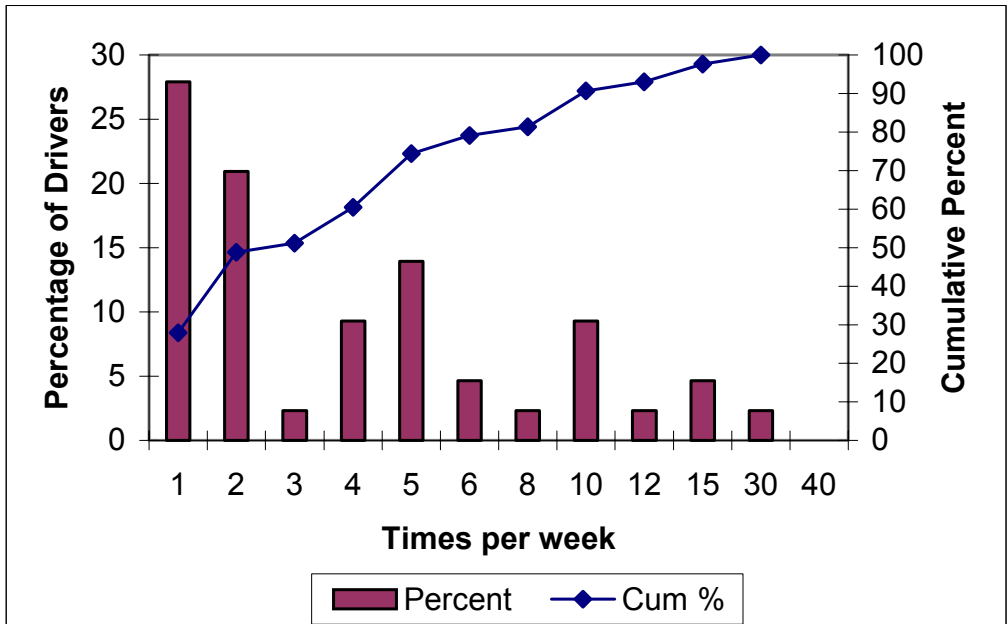


Figure 2: Distribution of number of times the drivers used Beckwith Road crossing.

Chestnut Street in Glenview: A total of 103 drivers reported using the Chestnut Street crossing. Figure 3 shows the frequency of usage of the crossing by the drivers. On the average, the drivers used this location 5.2 times per week. The percentage of the drivers who used this crossing up to two times per week was 43.7%. About 90.3% of the drivers used this location up to 10 times per week. The maximum usage reported for this crossing was 30 times per week.

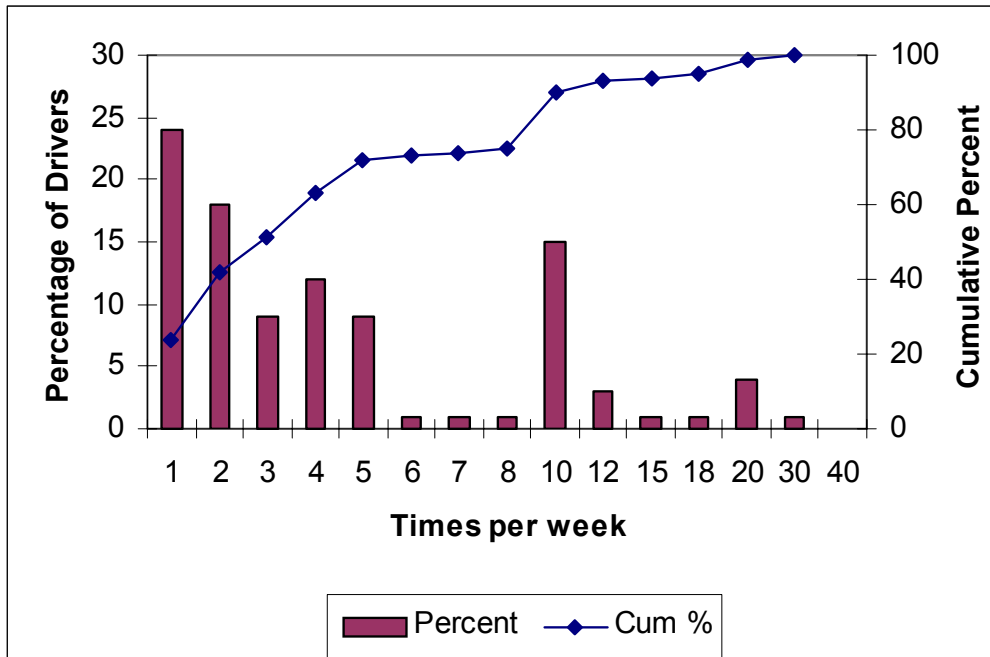


Figure 3: Distribution of number of times the drivers used Chestnut Street crossing.

Shermer Road in Northbrook: A total of 81 drivers reported using the Shermer Road crossing. Figure 4 shows the frequency of usage of the crossing by the drivers. On the average, the drivers used this location 5.3 times per week. The percentage of the drivers who used this crossing up to two times per week was 34.6%. About 91.4% of the drivers used this location up to 10 times per week. The maximum usage reported for this crossing was 20 times per week.

Dundee Road in Northbrook: A total of 79 drivers reported using the Dundee Road crossing. Figure 5 shows the frequency of usage of the crossing by the drivers. On the average, the drivers used this location 6.1 times per week. The percentage of the drivers who used this crossing up to two times per week was 38.0%. About 89.9% of the drivers used this location up to 11 times per week. The maximum usage reported for this crossing was 22 times per week.

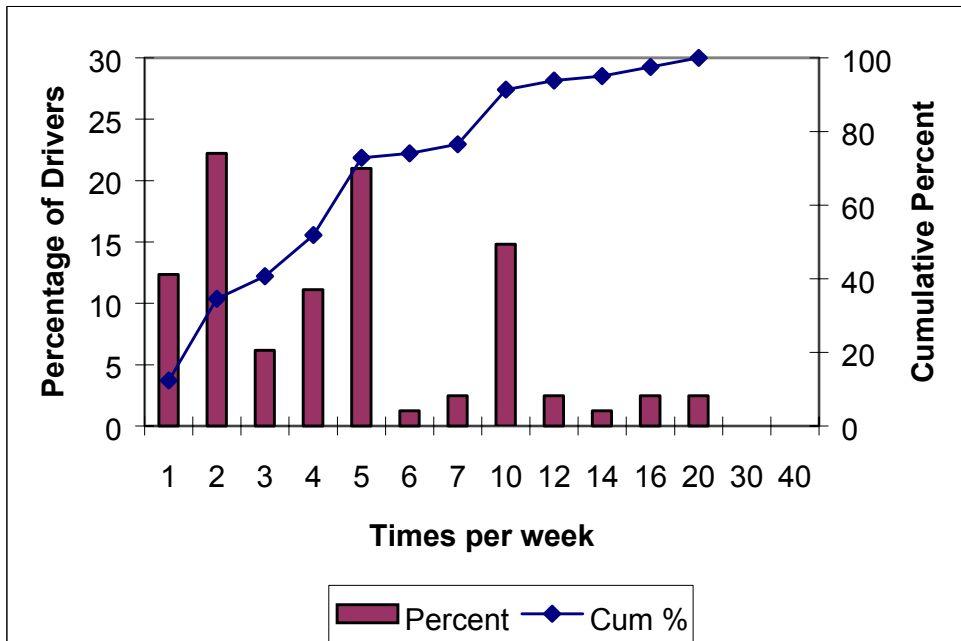


Figure 4: Distribution of number of times the drivers used Shermer Road crossing.

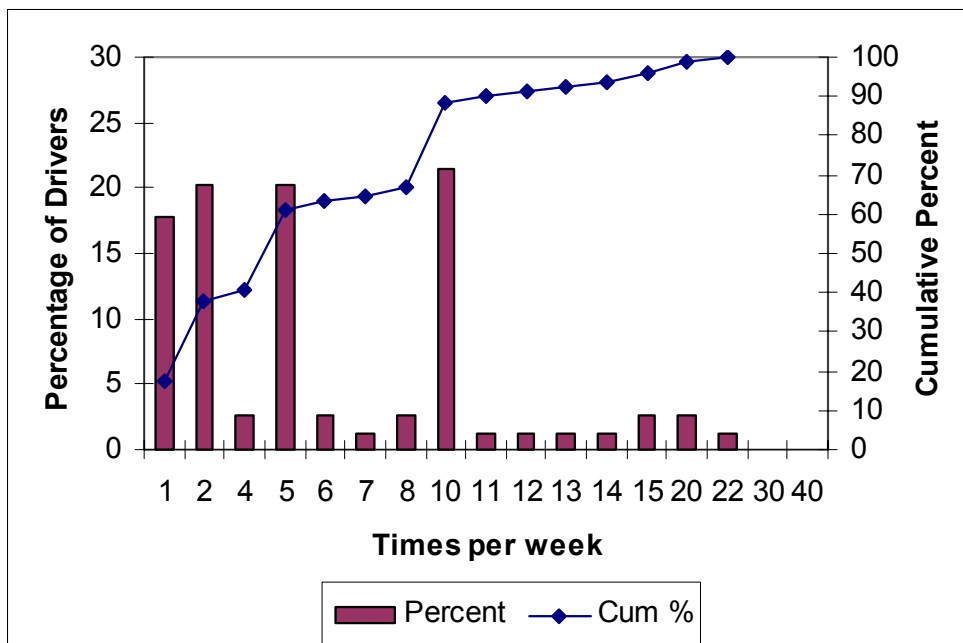


Figure 5: Distribution of number of times the drivers used Dundee Road crossing.

Greenwood Avenue in Deerfield: A total of 27 drivers reported using the Greenwood Avenue crossing. Figure 6 shows the frequency of usage of the crossing by the drivers. On the average, the drivers used this location 8.4 times per week. The percentage of the drivers who used this crossing up to two times per week was 40.7%. About 88.9% of the drivers used this location up to 20 times per week. The maximum usage reported for this crossing was 40 times per week.

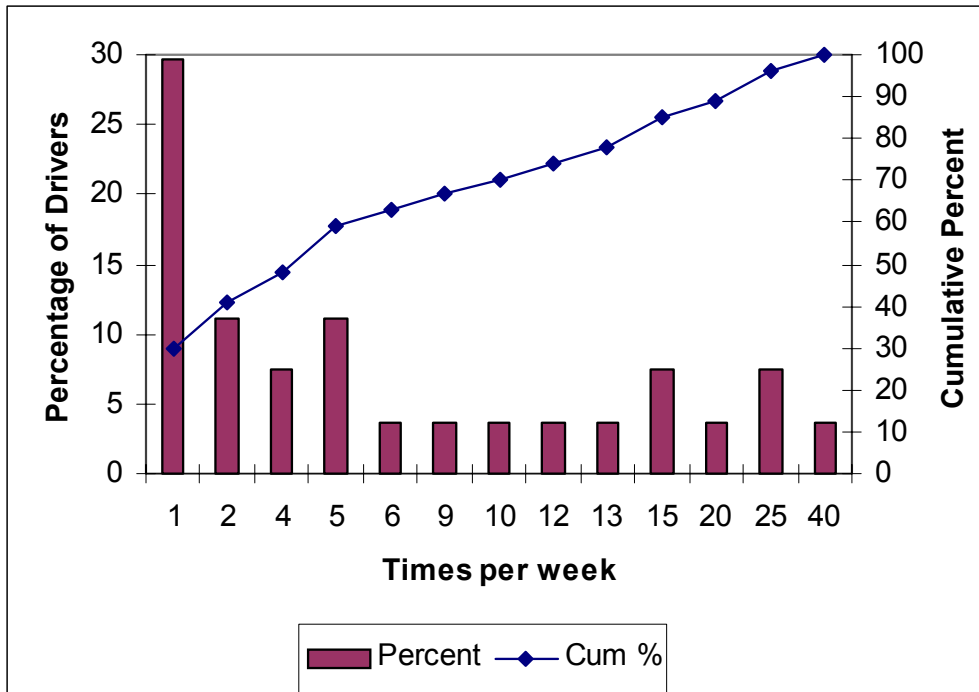


Figure 6: Distribution of number of times the drivers used Greenwood Avenue crossing.

Rate the Effectiveness of the Railroad Crossing Warning Devices (Q3)

The number of drivers who answered this question varied from 189 to 195 depending on the warning device. The drivers were asked to select one of the five rating categories: very high (5 points), high (4 points), medium (3 points), low (2 points), and very low (1 point). The results showed that the crossing gate is perceived as the most effective warning device. As shown in Table 3, about 76.4% of the drivers rated its effectiveness as “very high”. Approximately 48.7% of the drivers said that the

effectiveness of the flashing lights was “very high”. The effectiveness of the train horn and clanging bell were rated as “very high” by 36.6% and 38.1%, respectively. The effectiveness of the IVR, the advance warning sign and the crossbuck sign were rated “very high” by 21.5%, 14.9% and 12.7% of the drivers, respectively. The distribution of the effectiveness ratings are given in Figure 7 and Table 3. The figure shows that the crossing gate was considered highly effective by a large majority of the drivers. In Table 3, the no opinion group for the IVR was the highest of all the warning devices.

The average effectiveness of each device is given in Table 3. The highest score is 5. The average effectiveness results indicated that the effectiveness of the crossing gate was the highest followed by the flashing lights, the clanging bell and the train horn, the crossbuck, the IVR and lastly, the advance warning sign. The average effectiveness rating for the IVR was “medium”. Tables 3a and 3b show the distribution of the responses for each mode.

The effectiveness of the IVR was rated “very high” by 21.5%, “high” by 19.4%, medium by 23.0%, “low” by 12.0%, and “very low” by 12.6%. About 11.5% had no opinion on its effectiveness. Thus, over 40% of the drivers considered the effectiveness of the IVR high or very high, while over 24% rated it low or very low. The effectiveness rating for the IVR is much less than the ratings for the active warning devices. This is partially due to the fact that the IVR was not the primary warning device at these crossings. The IVR was supplementary to the active warning devices that were present at the crossings.

A comparison between the effectiveness of the IVR with respect to the other warning devices was conducted by using T-test procedures. A total of 154 drivers who provided a rating for all warning devices were chosen to make the analysis. Some of these drivers had the audible and the others had the visual mode of the IVR. When the responses from these two groups are combined, with a significance level of 0.05, the IVR was rated less effective than the flashing lights, crossing gate, clanging bell, and train horn; it was equally effective as the crossbuck and advance warning signs. These results are presented in Table 4 along with the mean differences between the devices, the standard deviations, the T – distribution values and their respective probabilities. The

ratings for each mode are analyzed separately in the next section. Some of these drivers had the audible and the others had the visual mode of the IVR.

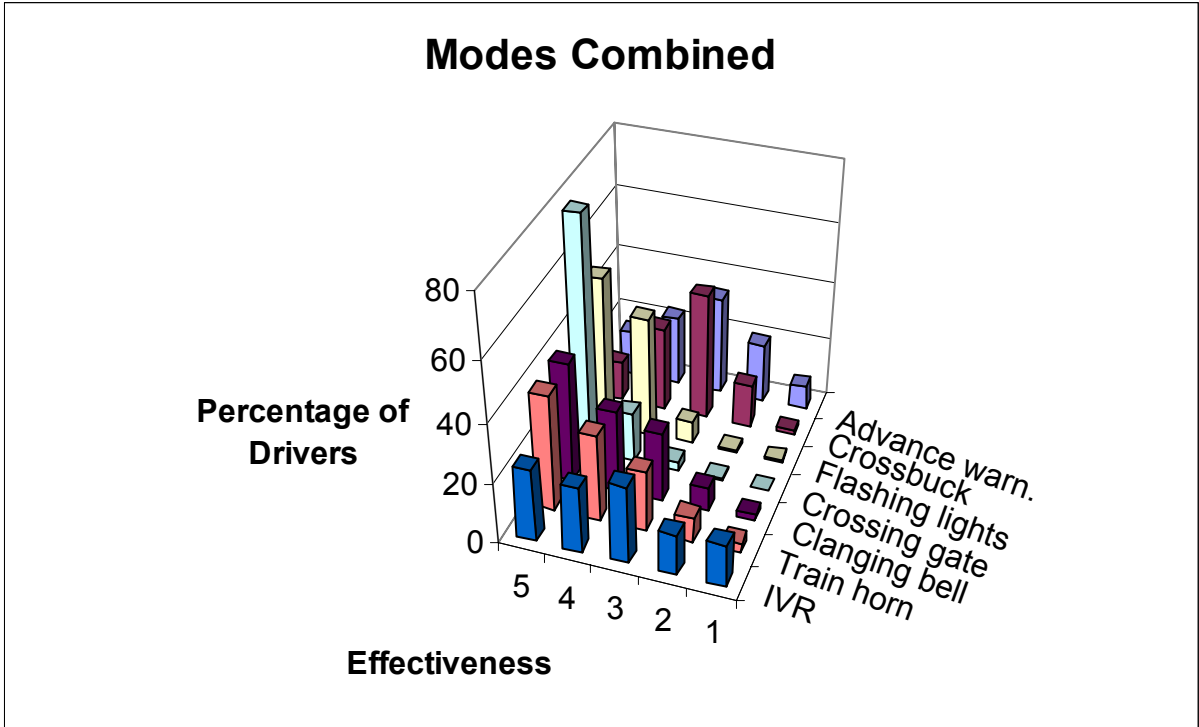


Figure 7: Percentage of all drivers rating the effectiveness of each railroad warning device.

Table 3: Percentages of drivers and ratings of effectiveness of warning devices



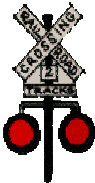
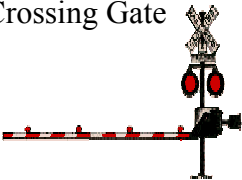
Warning Device	No opinion	Effectiveness						No. of drivers
		1	2	3	4	5	Average	
Advance Warning Sign 	4.0	7.7	19.0	31.8	22.6	14.9	3.2	187
Crossbuck Sign 	4.2	1.6	13.8	40.7	27.0	12.7	3.4	181
Flashing Lights 	4.3	0.5	1.0	7.3	38.2	48.7	4.4	183
Crossing Gate 	3.1	0.0	1.0	3.1	16.4	76.4	4.7	189
Clanging Bell	4.3	2.1	7.4	22.2	25.9	38.1	3.9	181
Train Horn	5.8	3.1	7.9	19.4	27.2	36.6	3.9	180
IVR	11.5	12.6	12.0	23.0	19.4	21.5	3.3	169

Table 3a: Percentages of drivers and ratings of effectiveness of warning devices for AUDIBLE mode



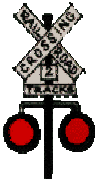
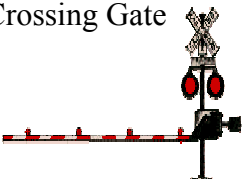
Warning Device	No opinion	Effectiveness						No. of drivers
		1	2	3	4	5	Average	
Advance Warning Sign 	6.1	8.8	22.5	28.8	18.8	15.0	3.1	75
Crossbuck Sign 	6.3	2.5	13.9	44.3	17.7	15.3	3.3	74
Flashing Lights 	7.3	1.3	0.0	11.3	38.8	41.3	4.3	74
Crossing Gate 	4.9	0.0	2.4	2.4	12.2	78.1	4.7	78
Clanging Bell	6.3	2.5	11.4	24.1	20.3	35.4	3.8	74
Train Horn	6.1	2.5	8.8	18.8	26.3	37.5	4.0	75
IVR	17.7	10.1	8.9	27.8	16.5	19.0	3.3	65

Table 3b: Percentages of drivers and ratings of effectiveness of warning devices for VISUAL mode



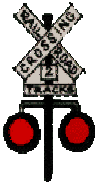
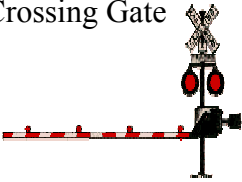
Warning Device	No opinion	Effectiveness						No. of drivers
		1	2	3	4	5	Average	
Advance Warning Sign 	2.6	7.0	16.5	33.9	25.2	14.8	3.2	112
Crossbuck Sign 	2.7	0.9	13.6	38.2	33.6	11.0	3.4	107
Flashing Lights 	1.8	0.0	1.8	4.5	37.8	54.1	4.5	109
Crossing Gate 	1.8	0.0	0.0	3.5	19.5	75.2	4.7	111
Clanging Bell	2.7	1.8	4.5	21.0	30.0	40.0	4.1	107
Train Horn	5.4	3.6	7.2	19.8	28.0	36.0	3.9	105
IVR	7.1	14.3	14.3	19.6	21.4	23.3	3.3	104

Table 4: T-test results for audible and visual groups together (154 drivers)				
Difference	Mean difference	Standard Deviation	T	Prob. T
Advance Warning – IVR	-0.18	1.62	-1.34	0.1816
Crossbuck Sign – IVR	-0.01	1.51	0.05	0.9574
Flashing Lights – IVR	1.05	1.47	8.87	0.0001
Crossing Gate – IVR	1.40	1.40	12.41	0.0001
Clanging Bell –IVR	0.61	1.56	4.85	0.0001
Train Horn – IVR	0.54	1.67	4.05	0.0001

IVR Effectiveness Ratings by the Visual and Audible Groups

In the previous section, we discussed the IVR effectiveness ratings for the audible and visual groups combined. In this section, the responses from the audible and visual groups are analyzed separately. Figures 8 and 9 (also Tables 3a and 3b) present the distribution of the effectiveness ratings for the warning devices given by the audible and visual groups. The average effectiveness ratings are summarized in Table 5. The t-test results indicate that the audible and visual groups gave similar effectiveness ratings for all warning devices except the clanging bell. The drivers in the visual group rated the effectiveness of the clanging bell higher than the audible group. The IVR average effectiveness rating from the audible group was 3.3 and from the visual group it was 3.4. One explanation for this is that the drivers in the visual mode had the IVR in the audible mode before, so they were paying more attention to its presence and thus, its effectiveness.

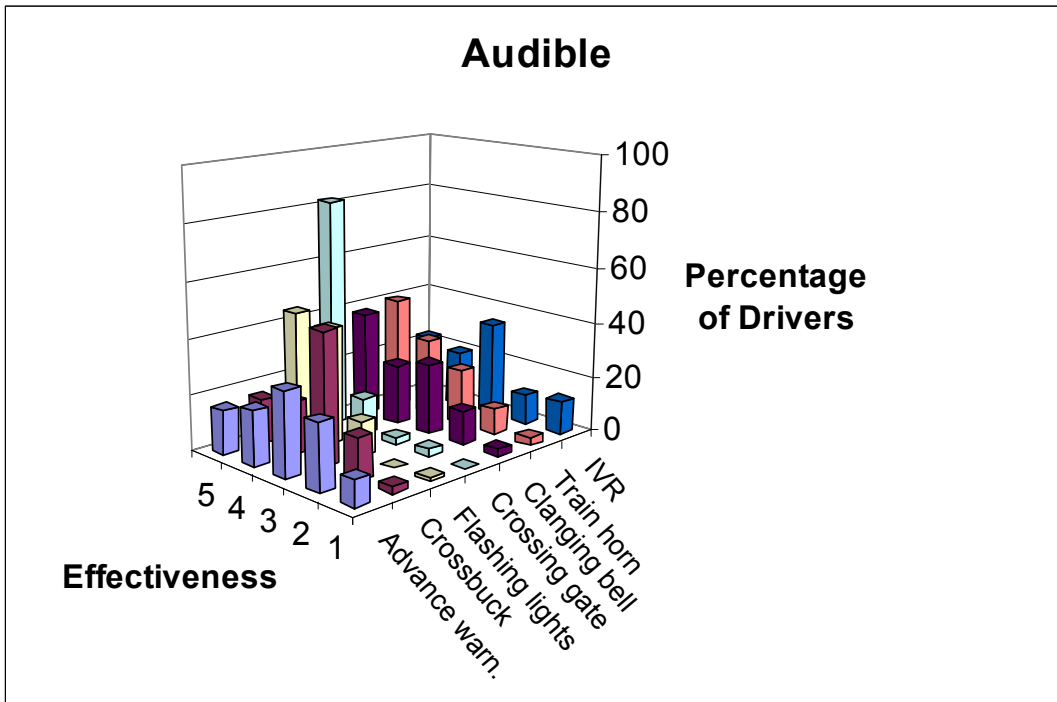


Figure 8: Percentage of drivers using audible mode, rating effectiveness of each railroad warning device.

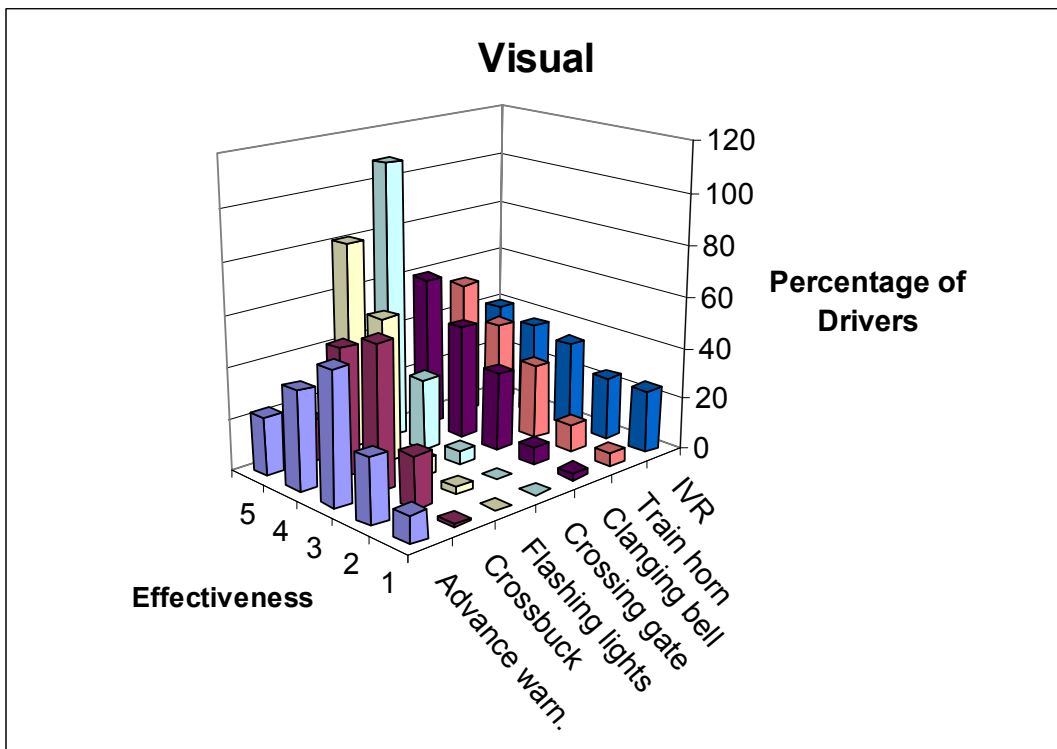


Figure 9: Percentage of drivers using visual mode, rating effectiveness of each railroad warning device.

Table 5: T-test results comparing audible and visual responses for every warning device (62 drivers in Audible and 92 drivers in Visual = 154 drivers)

Warning Device	Mean		Standard Deviation		T	Prob. T
	A*	V*	A	V		
Advance Warning	3.0**	3.2	1.2	1.1	-1.02	0.3078
Crossbuck Sign	3.2	3.4	1.0	0.9	-0.80	0.4247
Flashing Lights	4.3	4.4	0.7	0.7	-0.99	0.3232
Crossing Gate	4.8	4.7	0.6	0.5	0.59	0.5534
Clanging Bell	3.7	4.1	1.2	0.9	-2.09	0.0388
Train horn	3.8	3.9	1.1	1.0	-0.43	0.6691
IVR	3.3	3.4	1.3	1.4	-0.24	0.8112

* Notation: A = Audible mode, V = Visual mode

** Ratings are based in a 5 unit scale, 1 is low and 5 is very high

The comparisons of the effectiveness ratings between the warning devices and the IVR are presented in Tables 6 and 7. These responses correspond to 62 drivers using the audible IVR mode and 92 drivers in the visual mode.

Table 6 shows that the effectiveness of the crossbuck and the advance warning signs are equal to the audible mode of the IVR device, using a significance level of 0.05. The ratings for the audible IVR are significantly lower than the flashing lights, crossing gate, clanging bell, and train horn.

Table 6: T-test results for audible mode of IVR with other devices (62 drivers)				
Difference	Mean difference	Standard Deviation	T	Prob. T
Advance Warning – IVR	-0.26	1.70	-1.20	0.2360
Crossbuck Sign – IVR	-0.05	1.57	-0.24	0.8094
Flashing Lights – IVR	1.02	1.45	5.50	0.0001
Crossing Gate – IVR	1.47	1.35	8.55	0.0001
Clanging Bell – IVR	0.42	1.59	2.07	0.0426
Train horn – IVR	0.53	1.67	2.51	0.0146

Table 7 presents the results of the T-test between the effectiveness of the visual IVR mode and the warning devices. The devices that have ratings statistically equal to the ratings of the IVR with a significance level of 0.05 are the advance warning sign and the crossbuck sign. The rating for the visual IVR is significantly lower than the other warning devices.

Difference	Mean difference	Standard Deviation	T	Prob. T
Advance Warning – VR	-0.12	1.57	-0.73	0.4683
Crossbuck Sign – IVR	0.02	1.47	0.14	0.8873
Flashing Lights – IVR	1.08	1.49	6.92	0.0001
Crossing Gate – IVR	1.36	1.44	9.04	0.0001
Clanging Bell – IVR	0.74	1.53	4.62	0.0001
Train horn – IVR	0.55	1.69	3.15	0.0022

**Do You Trust your IVR to Give an Accurate Warning of a Train Approaching/
Occupying the Equipped Crossings (Q4)?**

A total of 202 drivers responded this question. Overall, 14.4% of the drivers indicated that they trusted the IVR very much, 38.1% trusted the IVR to some degree, 36.1% did not trust the IVR at all, and 11.4% of the drivers had no opinion or did not answer. The distribution of the drivers’ responses is given in Figure 10. The Chi-square test between the audible and visual groups indicates that they trusted IVR to the same degree. The chi-square value is 0.311 with a p-value of 0.856. About 60.6% of the drivers using the audible mode and 58.4% of the drivers using the visual mode trusted their IVR. As can be seen from Table 8, there is no significant over or under representation.

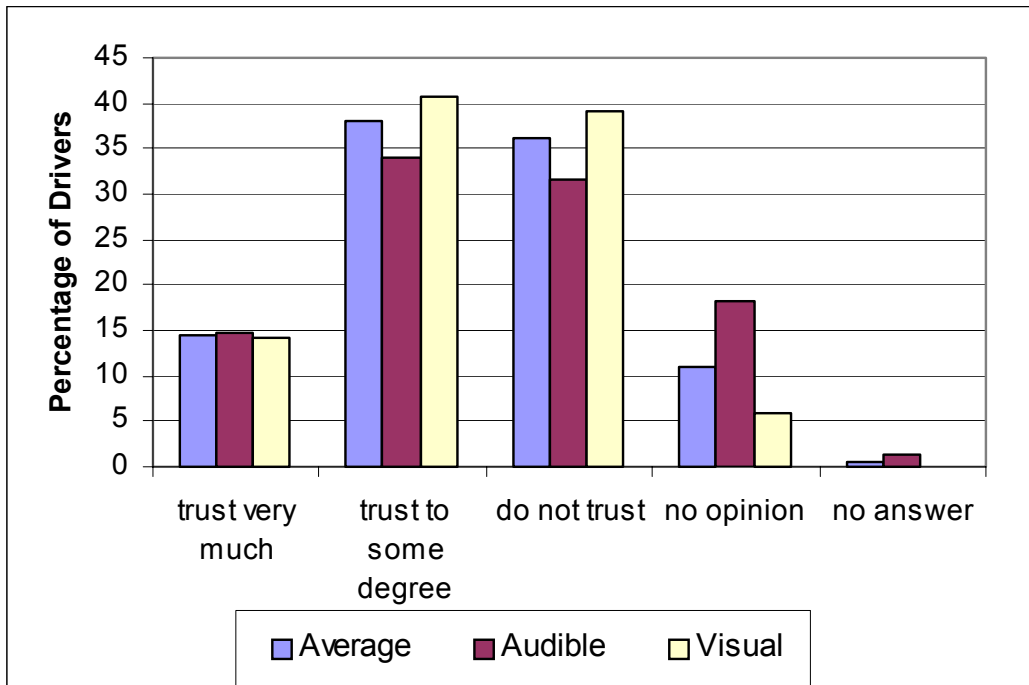


Figure 10: Percentage of drivers that trust the IVR to give an accurate warning of train approaching or occupying equipped crossings.

		Trust very much		Trust to some degree		Do not trust	
		A	V	A	V	A	V
Observed	Frequency	12	17	28	49	26	47
	Percent	18.2	15.0	42.4	43.4	39.4	41.6
Expected	Frequency	10.7	18.3	28.4	48.6	26.9	46.1
	Percent	16.2	16.2	43.0	43.0	40.8	40.8

Have You Experienced Any Problems with the IVR Powering On Properly (Q5)?

A total of 202 drivers responded to this question. Approximately 52.5% of the drivers did not encounter any problems with the IVR powering on properly, but 23.3% of the drivers experienced problems. About 22.3% of the drivers did not recall or had no opinion on problems with the IVR and 1.9% of the drivers did not respond to the question. Figure 11 presents the distribution of the drivers' responses.

The drivers were also requested to write the number of times the power-on problems occurred. A total of 27 drivers provided a numeric response. Ten of these drivers were operating an audible IVR and the remaining 17 were operating in the visual mode. Visual IVR drivers reported that power-on problems occurred an average of 5.1 times, while audible IVR drivers reported that power-on problems occurred an average of 7.1 times. This difference is not statistically significant based on the analysis results obtained from a T-test.

A comparison of the responses given by 198 drivers operating audible and visual modes is presented in Table 9. The chi-square test was used to see if the values obtained for audible and visual drivers were similar to the ones expected. The chi-square test shows that the responses were similar with 95% confidence. The chi-square value is 0.436 with a p-value of 0.804.

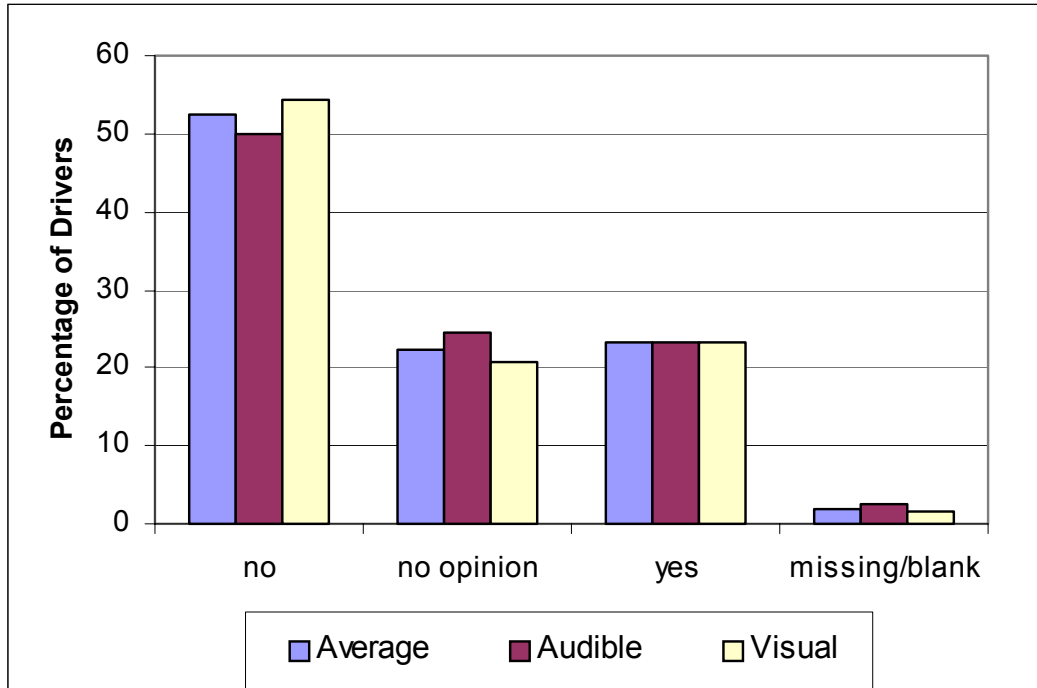


Figure 11: Distribution of drivers that experienced power-up problems.

Table 9: Chi-square test results							
(80 drivers in Audible and 118 in Visual)							
		No power-on problems		Don't recall/No opinion		Yes, had power-on problems	
		A	V	A	V	A	V
Observed	Frequency	41	65	20	25	19	28
	Percent	51.2	55.1	25.0	21.2	23.8	23.7
Expected	Frequency	42.8	63.2	18.2	26.8	19.0	28.0
	Percent	53.5	53.6	22.8	22.7	23.8	23.7

How Many Times has Your IVR Given You a Warning When a Train Was Not Approaching/Occupying the Equipped Crossings (Q6)?

This question requested a numeric response, however a large number of drivers did not give a numeric response, but responded with words like “many” and “numerous”. Only 97 drivers provided numeric responses. On the average, the IVR gave a message when a train was not approaching/occupying the equipped crossings 5.5 times in a three month period. The minimum and maximum values reported by the drivers were 0 and 65. Fifty six of the drivers that provided an answer were using the visual mode and 41 drivers were using the audible mode. The drivers using the visual IVR reported 5.7 false alerts on the average, while the drivers using the audible IVR reported 5.3 false alerts in the three-month period. The difference is not statistically significant with a confidence level of 95%. Based upon interaction with the drivers during orientation and focus group sessions, it is believed that the actual number of false alerts were much higher than these averages.

How Many Times Has Your IVR Failed to Give You a Warning When a Train Was Approaching/Occupying Equipped Crossings (Q7)?

On the average, the 95 drivers who answered this question stated that the IVR failed to give a warning when a train was approaching 1.4 times in three months. Forty one of these drivers had the IVR in the audible mode and they reported that the IVR failed to give a warning on average 1.1 times. The range of the responses was from 0 to 20. The highest number reported for IVR failures to give a warning message when a train was approaching was 20 times in three months. This number was reported by two drivers in the visual group. Fifty four drivers with the IVR in the visual mode reported that the IVR failed approximately an average of 1.6 times in three months. The difference is not statistically significant at a significance level of 0.05. None of these missed alerts were reported to the special contractor hotline established to communicate system problems.

What Percentage of the Time has Your IVR Provided You a Warning When a Train Was Approaching /Occupying the Equipped Crossings (Q8)?

A total of 115 drivers answered this question. On the average, they stated that the IVR provided a warning when a train was approaching 63.9% of the time. The averages for the drivers using the visual and audible IVR were 65.8% and 62.6% of the time, respectively. The difference in the responses between the audible and visual modes is not statistically significant using a T-test with a significance level of 0.05. Approximately, 50.4% of the drivers said that the IVR worked at least 90% of the time, of these 44.3% of the drivers found that the IVR gave a correct signal 100% of the time. It is suspected that there were drivers who did not understand the question correctly since 17.4% of the drivers stated that the IVR gave a correct signal zero percent of time.

Has the IVR Given You a Signal that You Did Not Understand (Q9)?

Out of 198 drivers who responded to this question, only 18 drivers received a signal that they did not understand. The drivers were asked to provide a description of the signal given. Ten of these drivers responded that they received a non-understandable signal an average number of 8.0 times in three months. The actual statements are given in Table 10. Drivers mostly reported false alerts they received as signals that they did not understand.

Table 10: Verbatim messages the drivers did not understand
Signal would go off on streets not near railroad tracks.
Never worked when a train was near. Would only work when no train was near
Train indication in Jewel parking lot
Many times in downtown
Beeping (in visual mode)
Different sound (in visual mode)
IVR would emit a signal for: police radar, automatic door openers, stop with a lot of neon lights, HPK Hospital Sunset foods (HPK), banks or business offices, at Church and Skokie Blvd.

RESPONSES SPECIFIC TO VISUAL IVR MODE

The results discussed in the following sections are based upon responses from 120 drivers using the IVR in visual mode.

Visual Distractions During Daily Driving Conditions (Q10)

About 38.3% of the drivers said they were distracted from passengers during daily driving, 37.5% of the drivers were distracted by exterior light sources, 17.6% by interior warning lights, and 33.3% did not provide any answers. The distribution of the visual distractions is presented in Figure 12. Approximately 4.2% of the drivers complained of other distractions. These additional distractions are presented in Table 11. Please note that this is a “circle all that apply” and thus, the percentages do not add up to 100%.

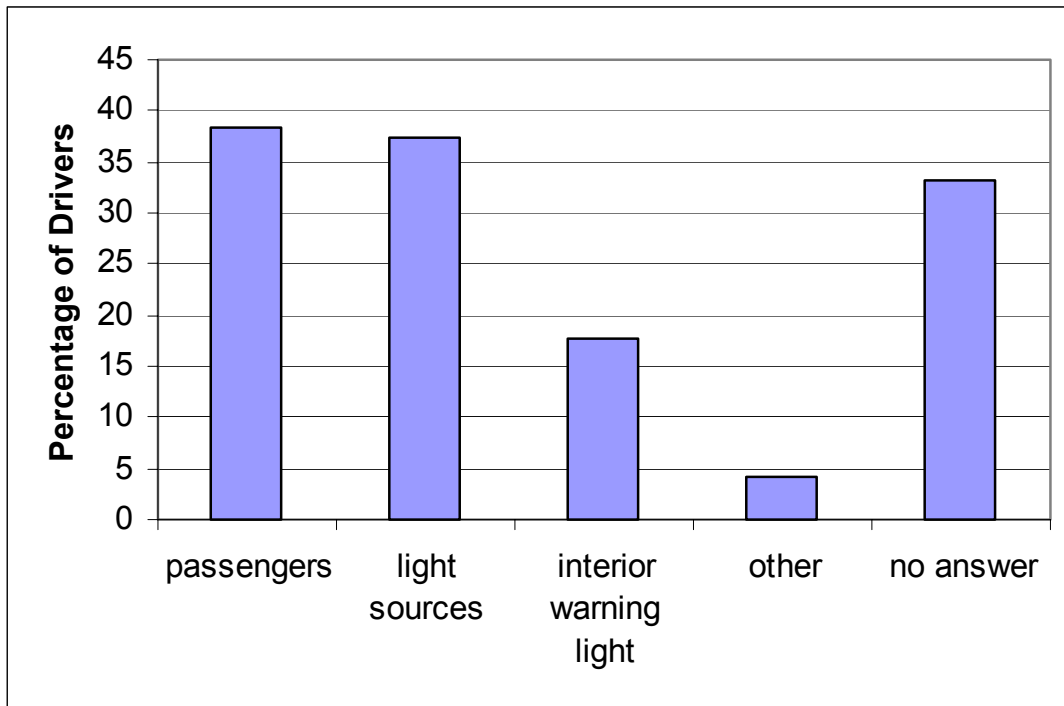


Figure 12: Visual distractions drivers experienced during driving.

Table 11: Additional Visual Distractions
Chimes
Cell phone calls
Road rage
Radio
Passenger lights near front windshield
Exterior lights from bus reflecting off front windshield

During Daytime and Nighttime, How Well Can You See the Visual Display (Q11)?

Figure 13 shows that the opinions of the drivers do not vary considerably from daytime and nighttime. During daytime, 70.0% the drivers stated the visual display was “just right”, 16.7% said that the display was too dim, and 13.3% had no opinion or did not answer the question. None of the drivers said that the display was too bright.

During nighttime, the majority of the drivers (60.0%) said that the visual display was “just right”, 1.7% said that it was too dim, and 38.3% of the drivers had no opinion or did not answer the question. None of the drivers thought that the display was too bright.

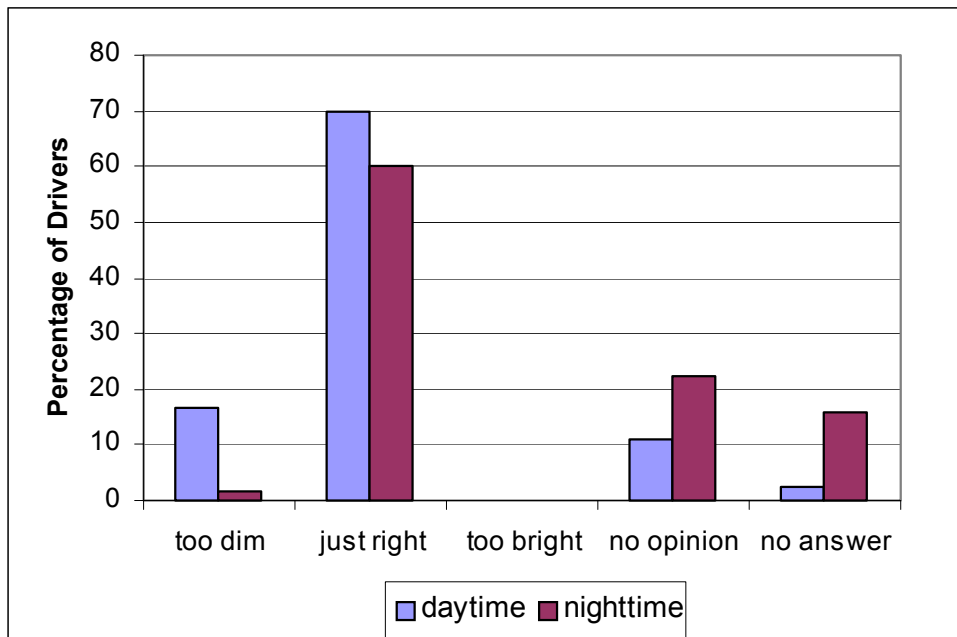


Figure 13: How well drivers can see the visual display during daytime and nighttime.

Is the Size of the Lettering on the Visual Display Easy to Read (Q12)?

The distribution of the drivers' responses is shown in Figure 14. Approximately 80.0% of the drivers considered the lettering on the visual display to be easily readable. On the other hand, 9.2% found the lettering to be too small, and 10.8% of the drivers had no opinion.

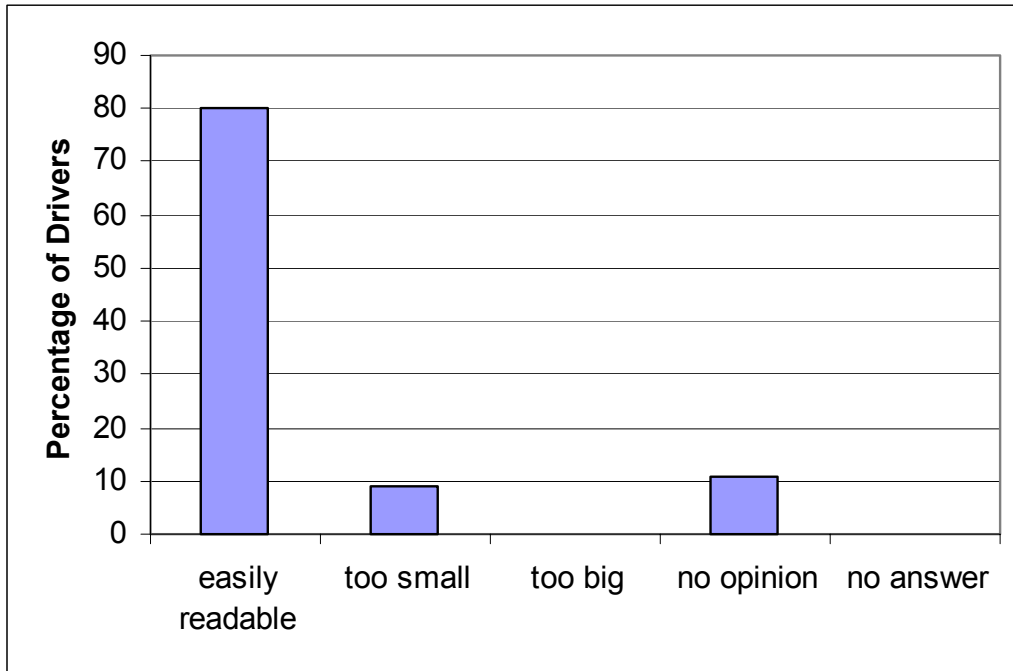


Figure 14: Distribution of drivers' opinions on the size of the lettering on the visual display.

How Does the Blinking Rate of the Warning Message Affect Readability (Q13)?

Figure 15 shows the distribution of the answers of the drivers on the blinking rate of the visual message. Approximately 65.8% of the drivers said that the visual message blinked at the right speed, 3.3% of the drivers said the message blinked too fast, while 1.7% thought that it blinked too slowly. Approximately 27.6% of the drivers had no opinion and 1.6% did not answer this question.

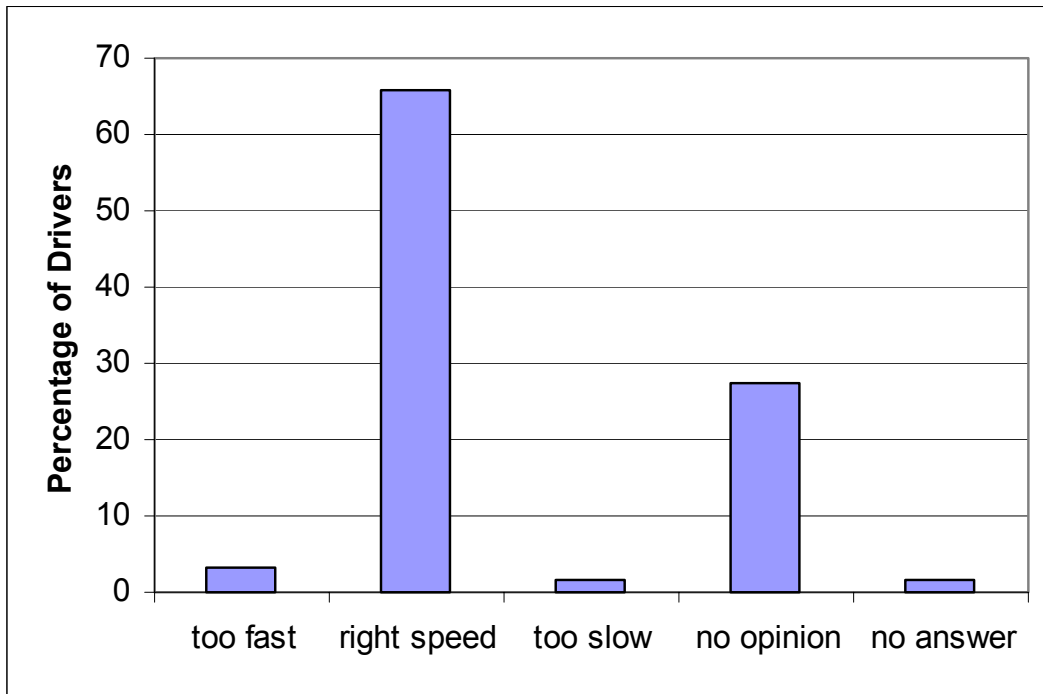


Figure 15: Distribution of the drivers' opinions on the visual message-blinking rate.

Is the Color of the Visual Warning Message Easily Noticed (Q14)?

Approximately 82.5% of the drivers said the color of the warning message was noticeable, while 5.8% of the drivers did not. Approximately 10.9% of the drivers had no opinion and 0.8% did not answer the question. The colors suggested by the drivers were red, a brighter white, orange or bright green.

Is the Visual Warning Message Easily Noticed (Q15)?

Figure 16 presents the distribution of the drivers' responses to this question. A large percentage of drivers (65.8%) said that the message was noticeable. On the other hand, 15.8% thought that the message was not noticeable enough compared to the other visual cues. Approximately 16.8% of the drivers did not have any opinion and 1.6% did not answer this question.

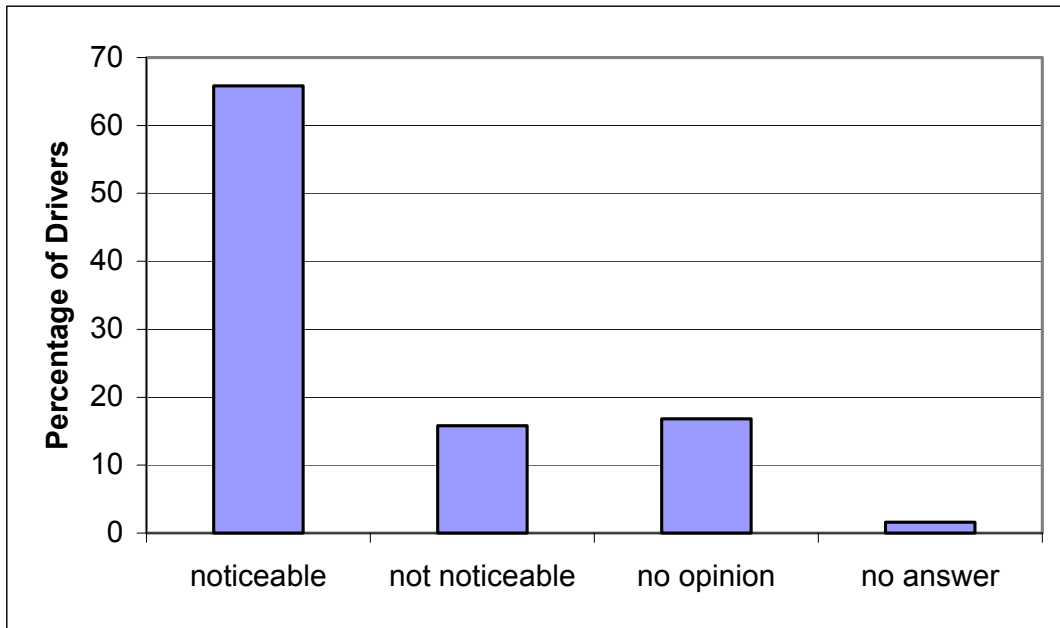


Figure 16: Is the visual message noticeable from other visual cues you receive while driving?

How Would You Rate the Overall Quality of the Visual Message You Received from your IVR (Q16)?

Figure 17 presents the distribution of driver responses to this question. Over half of the drivers (51.6%) rated the quality of the message as good or excellent. Approximately 26.7% of the drivers said that it was fair and 15.0% rated it poorly. Only 6.7% of the participants had no opinion.

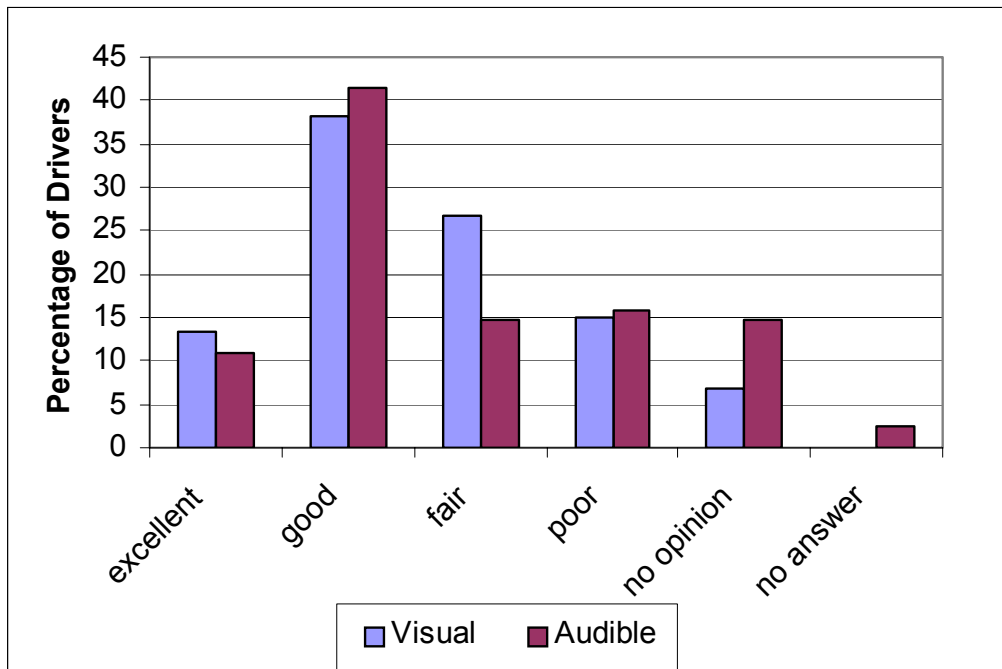


Figure 17: Ratings on the overall quality of the visual and audible messages.

RESPONSES SPECIFIC TO AUDIBLE IVR MODE

The results discussed in the following sections are based upon responses from 82 drivers using the IVR in the audible mode.

Audible Distractions That Apply During Daily Driving Conditions (Q10)

Figure 18 shows the distribution of responses from 82 drivers. A large portion of the drivers (69.6%) complained about the audible distractions caused by horns and sirens. About 59.8% of the participants found the background noise of radio and tapes disturbing. Approximately 43.9% complained about distractions caused by passengers. About 52.5% indicated that the engine of their vehicle was too loud and was in itself a distraction, and 7.2% mentioned other distractions that are listed in Table 12. Approximately 2.4% did not provide an answer. Some drivers gave more than one response to this question, so the percentages add up to more than 100%.

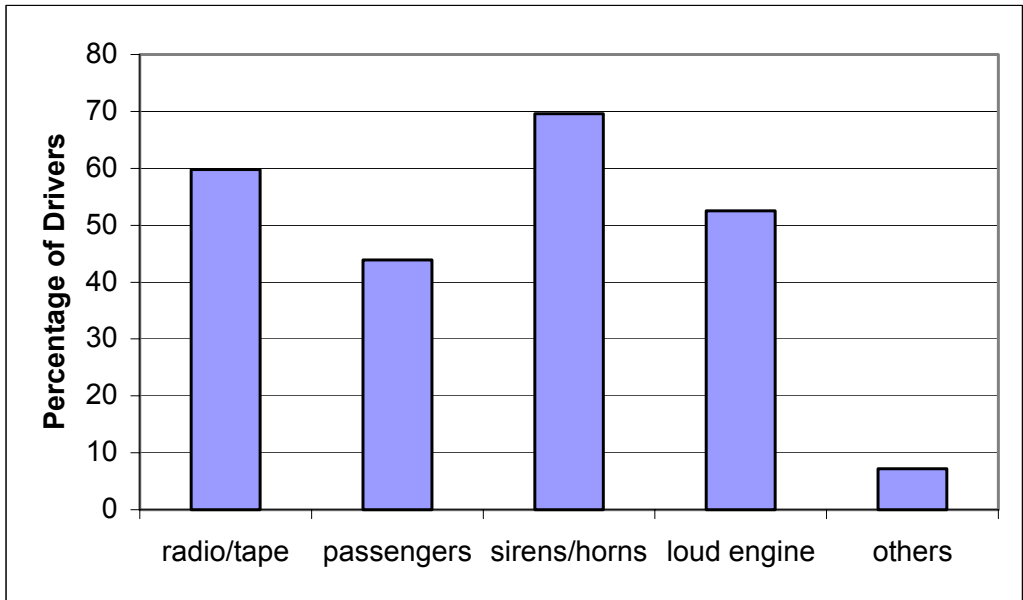


Figure 18: Audible distractions drivers experienced while driving.

Table 12: Additional Audible Distractions
Dispatch Radio
Poor Drivers
Fire Radio
Road/wind Noise
Two-way Radio
Police Radar
Other Vehicles/Traffic

How Well Can You Hear the Warning Tone from the IVR (Q11)?

Figure 19 presents the distribution of driver responses. Approximately 55.6% of the drivers thought that the warning tone was just right, 13.6% of the drivers found the warning tone was too soft, while 16.0% thought that it was too loud, 13.6% of the drivers had no opinion, and 1.2% did not answer the question.

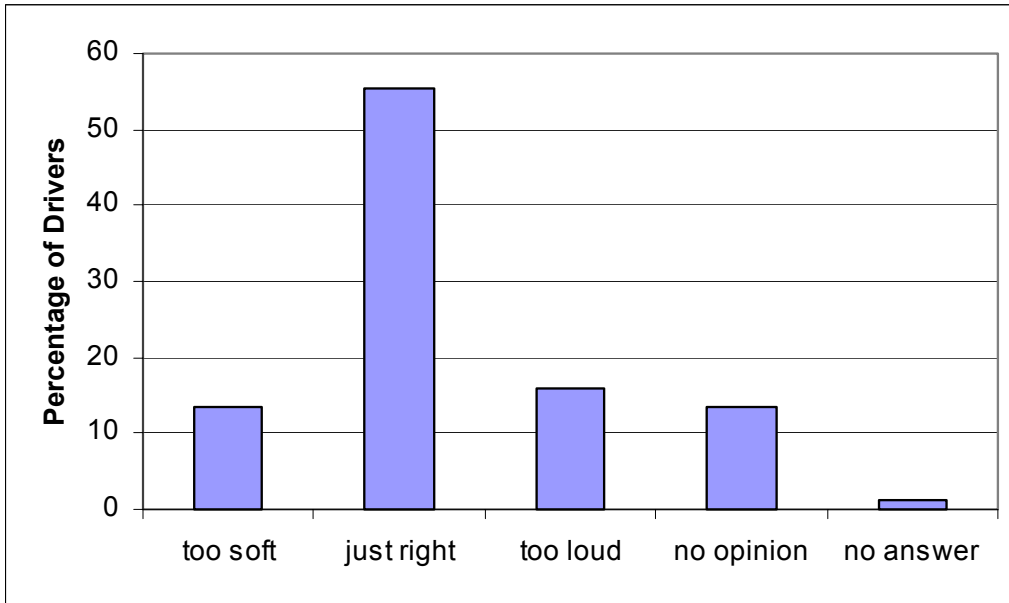


Figure 19: How well can drivers hear the warning tone?

How is the Quality of the Warning Tone (Q12)?

Figure 20 presents the distribution of the drivers' responses. A large percentage of the participants (58.5%) found the warning tone to be just right, 13.4% said that it was too harsh or piercing, but 6.1% thought that it was too dull or plain. About 20.7% of the drivers expressed no opinion and 1.3% of the drivers did not give an answer.

How is the Length of the Warning Tone (Q13)?

Figure 21 presents the distribution of the drivers' responses. Approximately 51.2% of the drivers thought that the warning tone beeped for the right length of time, 15.9% thought that the beeped warning tone was too long and 4.9% thought that it is too short. Approximately 28% of the drivers either had no opinion or did not give an answer to this question.

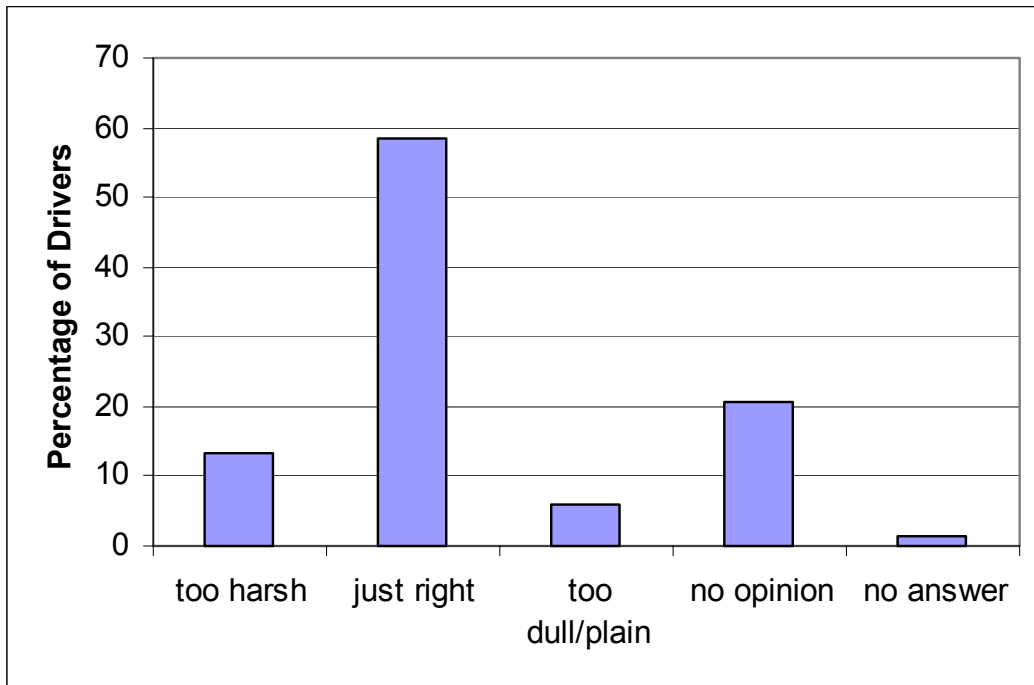


Figure 20: How is the quality of the warning tone?

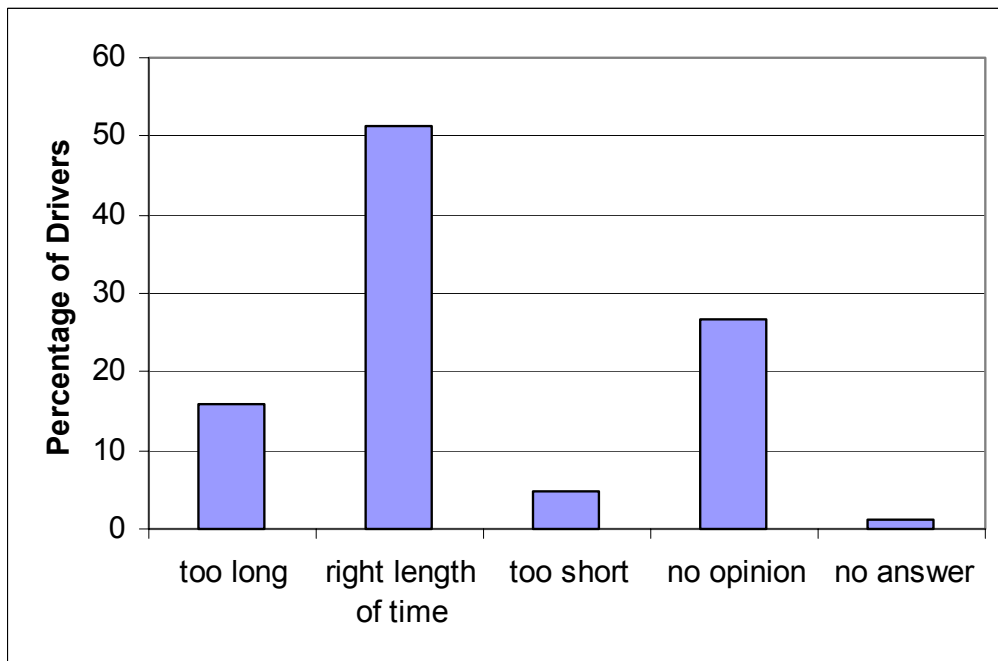


Figure 21: How is the length of the warning tone?

Is the Warning Tone Noticeable from other Audible Cues You Receive while Driving (Q14)?

Figure 22 presents the distribution of the drivers' responses. About 63.4% of the drivers said that the warning tone was noticeable, but 12.2% found the warning tone not noticeable. Approximately 19.5% had no opinion and 4.9% of the drivers did not answer the question.

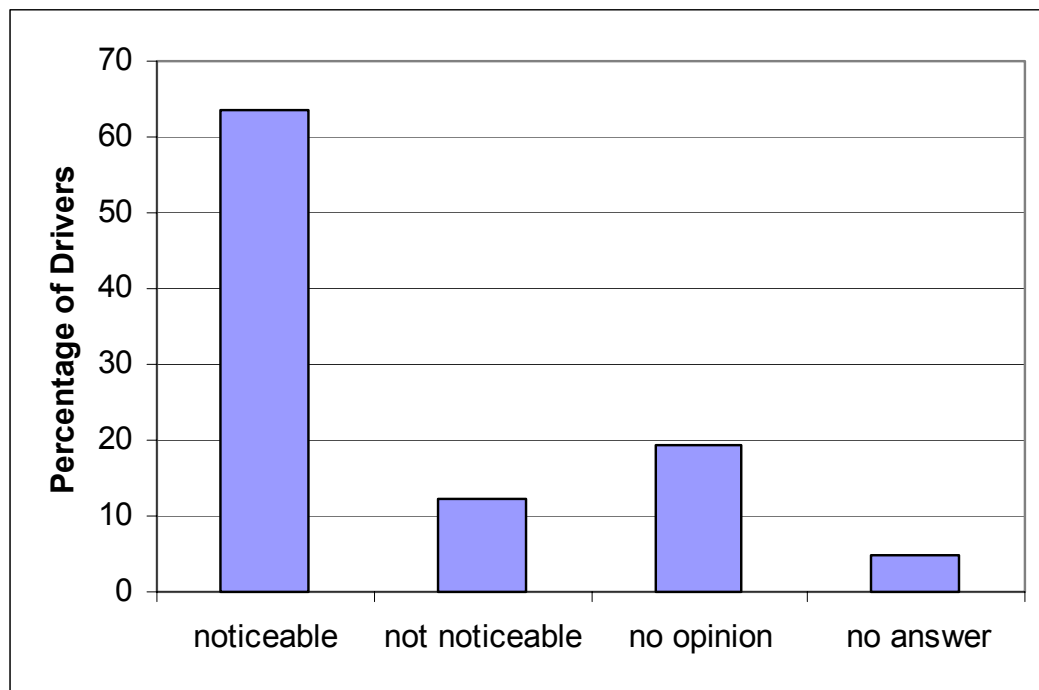


Figure 22: Is the warning tone noticeable from other audible cues you receive while driving?

How Would You Rate the Overall Quality of the Audible Message You Received from Your IVR (Q15)?

Figure 23 presents the ratings for the overall quality of the audible IVR message. About 11.0% of the drivers thought that the overall quality of the audible message was excellent, 41.5% thought it was good, 14.6% said that it was fair, and 15.9% thought it performed poorly. Approximately 14.6% of the drivers had no opinion and 2.4% left the question blank.

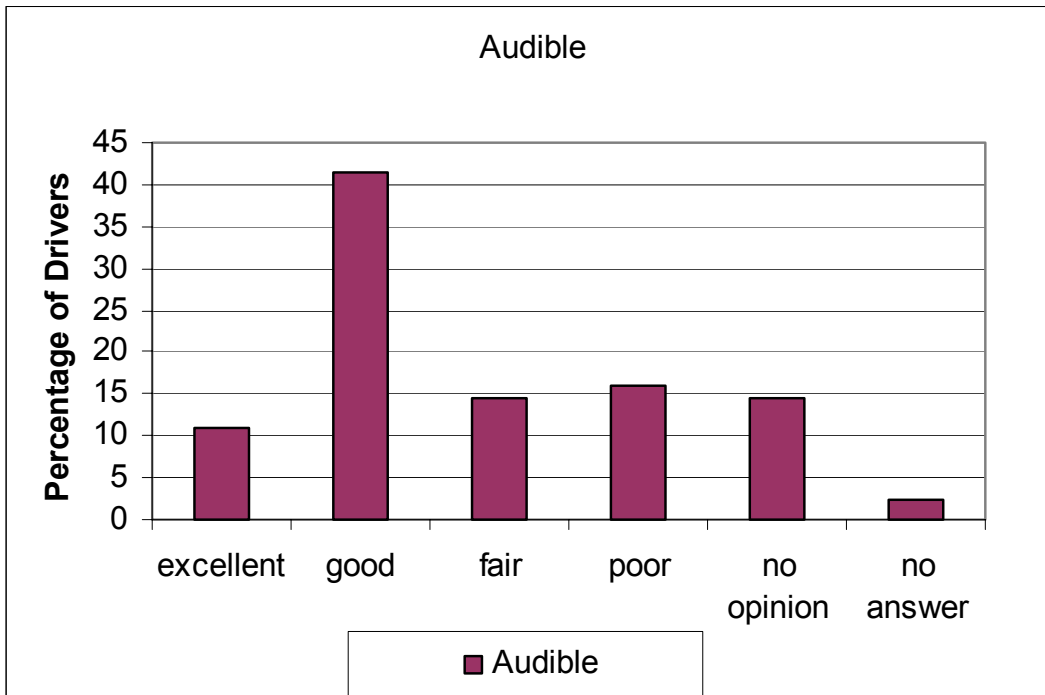


Figure 23: Ratings on the overall quality of the audible message

COMMENTS/SUGGESTIONS

Listed in Table 13 are the comments drivers made regarding the IVR operation in the visual and audible modes.

Table 13: Verbatim Comments about IVR Operation

Visual IVR Related Comments

1. Quit wasting the taxpayers money on bullshit programs.
2. The only time I noticed it was when a train was coming and I looked to see if it was working. If all other warning signs failed, I would not notice it.
3. I think visual warning is quite reliable.

4. Receiver activated by portable "speed" sign set up by local police department.
5. Would work better if IVR was audible as well as visual.
6. The transmitter some times doesn't work at crossings. I think they might have repaired it.
7. IVR should give warning a few seconds before gates close.
8. IVR is not needed.
9. Used to go off in visual often for no reason. Has not done this since audible started.
10. Some problems in the (Chicago) Loop.
11. The visual warning itself may have been easily overlooked. Especially when malfunctioning. The display wasn't bright enough.
12. Does it have to continually make the audible alert? Should sound once to alert or beep a few times and still have visual.
13. Blinks so often that it was usually not noticed.
14. Without the sound warning, I really don't pay too much attention to warning message.
15. From the beginning I felt the size of the letters were too small to definitely catch my eye and I still feel that way. The readout should be twice as high and in red or better yet it should be audible.
16. I don't recall signal going off but maybe because I was not at crossing when a train was passing.
17. It's great. Cars all should have one. Maybe there would be less railroad crossing accidents.
18. IVR does not seem to be working right. When turning on vehicle unit, it beeps and a green dot is displayed on the left side and stays on that is all no letters.
19. Urban areas not a good test. Although the unit works, I am stopped by traffic 100% of the time.
20. Used to get a lot of false warnings-has been completely corrected but still don't trust it. Never get warning while driving.
21. The message is not visible when it is bright and sunny.
22. Location of unit might be improved. It is out of visual line.
23. Driver has to watch the whole time. Maybe they help somebody, not me.

24. In vehicle receiver should be activated when a train gets close to the crossing, not when the lights start flashing and gates start coming down.
25. It is evident to me that this device is vulnerable to various sources of electromagnetic interference that makes it ineffective. It is imperative that this to be corrected to be 100% effective.
26. Without audio, the visual I feel is useless.
27. Audible signal would draw one's attention to the alert of an oncoming train.
28. Would like to know it is working before leaving the garage by giving it a test.
29. This needs an advance warning system not one that goes off at the same time as the lights and crossing gates.
30. Sometimes it is silent when there is a train on track in front of a bus.
31. This warning device is an excellent idea. It has saved me once. The device needs to be more consistent that it needs to work properly more than once in a while.
32. False signals, unreliable.
33. Too many false alarms, without audible warning, it is too likely that I won't see the lights-except when I am already stopped.
34. Visual-only too hard to notice. Sometimes I get a warning when I am not near any trains/tracks.
35. As a good driver, my eyes are always moving so probably that is why I noticed it more than others. Other people in my group say it doesn't work. Don't really pay attention. Also noticed it activates approx. 100 yards from crossing.
36. I think it is a good idea.
37. The unit never worked properly, the questions above about the lettering, beeps etc. were...
38. Compared to flashing lights and full-width crossing gates, the IVR system is worthless and a waste of time and \$\$\$.
39. The unit installed has never operated as advertised. The unit would cycle through the self-test at start up and afterward, never display a train warning.
40. IVR never activated.

Audible IVR Related Comments

Q16 Audible

1. Sorry but I think it is a bigger distraction having that in the truck. Work on earlier warning on the crossing gate.
2. The IVR activates at Walgreen and Dominick stores on Waukegan Road in Morton Grove.
3. It has never been set to visual since it was installed.
4. I have mentioned many times that I felt this equipment was either faulty or useless.
5. When we start the car, the device goes off otherwise, no one in the office remembers it ever going off.
6. Unit not working.
7. Other than power up, I had no operational experience with this equipment.
8. Have not driven a vehicle with receiver in 2000.
9. I am not a driver.
10. Did not drive an equipment with IVR.
11. Seems like a waste of money.
12. I don't see the point of taking my eyes and ears off of the road to look at/listen to a radio when I have my own eyes to detect danger.
13. Have not been at the crossing when train is approaching but many false tunes (activations) far from crossings.
14. Definitely need both audio and visual.
15. Never have seen it work yet.
16. Intersection we use runs parallel to Lehigh no trees or buildings. My best warning is visual of train.
17. Should have been both audible and visual to be effective.
18. The village should have put the receiver in another vehicle. I don't travel enough with the truck to accurately report.
19. Need to be fixed.
20. Didn't work for more than half of the year before.

21. This IVR seems to be in its early stage of effectiveness. It needs the bugs worked out, when you go by an OSCO or Walgreen it goes off or a bank, very poor quality.
22. Just get the bugs out as far as passing a lot of neon lights. Any Walgreens or Osco I go by it sounds.
23. I am no longer on one of the equipped trucks.
24. Beeps too long and often when in strip malls etc.
25. Except when starting the car the device has not done anything I remember
26. When did we get these?
27. Need to improve the quality of device.
28. Please take this out of my bus it is not needed. I do the proper things to cross railroad tracks and this equipment does not help me. It also goes off every time I pass a police car, ambulance etc. It really gets inappropriately repetitive.
29. Too soft to hear over passenger noise, sound similar to other warnings in the bus (engine and brake), can't really say it gives any benefits over gates and bells already in place. If it is activated before gates and bells and only when a train is moving, it would be better.
30. My IVR has not worked since last year. It is mounted too close to the heater and it is malfunctioning. I have no opinion on the IVR for the last 8 months.
31. On Rand Road before Palatine Road, receiver gives false alarm without the railroad tracks.
32. Change the sound of the beep or tone.
33. It does go off in non-crossing settings.
34. IVR went off too many times in store parking lots and various intersections where no train is around.
35. Don't mount them in police cars. They are too easily activated. It drives officers crazy.
36. This vehicle seems impractical in an emergency vehicle.

CONCLUSIONS

About 40.9% of the drivers considered the effectiveness of the IVR high or very high, while 24.6% rated it low or very low. The effectiveness rating for the IVR is much less than the ratings for the active warning devices. This is partially due to the fact that the IVR was not the primary warning device. It was supplementary to the active warning devices that were present at the crossings.

The audible and visual groups gave similar effectiveness ratings for all warning devices except the clanging bell. The drivers in the visual group rated the effectiveness of clanging bell higher than the audible group. The IVR average effectiveness rating from the audible group was 3.3 and from the visual group it was 3.4. With 95% confidence, the effectiveness of the audible IVR was similar to the crossbuck and the advance warning signs, but lower than the crossing gate, the flashing lights, the clanging bell, and the train horn. With 95% confidence, the effectiveness of the visual IVR was similar to the advance warning and the crossbuck signs, but lower than the other warning devices.

The audible and visual groups trusted the IVR to the same degree. About 60.6% of the audible group and 58.4% of the visual group trusted the IVR to give an accurate warning of a train approaching/occupying the equipped crossings. A false alert rate of 5.5 in three months (the range 0 to 65) was reported, and the rates were similar for the audible and visual groups. The false alert figures the drivers gave in the surveys are generally lower than what they said in the focus group meetings and in driver training/orientation sessions. Drivers stated that the IVR failed to give a warning when a train was approaching/occupying the equipped crossings an average of 1.4 times in three months (the range was 0 to 20).

The drivers in general were satisfied with the quality of the message from their IVR. For the visual mode, 51.6% of the drivers rated the overall quality of the message as good or excellent, 26.7% as fair, 15.0% said it was poor, and 6.7% had no opinion or did not respond. For the audible mode, 52.5% rated the overall quality of the audible message excellent or good, 14.6% as fair, 15.9% said it was poor, and 17% did not have an opinion or did not respond. A small percentage (14-16%) of drivers in the audible group said either the tone was too loud, too harsh or piercing, or it beeped for too long.

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2. Benekohal, R.F. and Aycin, M. F. "Analyses of Drivers' Opinions about Railroad Grade Crossings Traffic Control Devices and Safety: Background Survey", Report No, FHWA-IL/UI-TOL-10, March 2004, University of Illinois at Urbana-Champaign.
3. Benekohal, R.F. and Rawls, C. G., "Analyses of Drivers' Responses to In-Vehicle Receiver (IVR) After Experiencing Two Modes of Operation", Report No, FHWA-IL/UI-TOL-12, March 2004, University of Illinois at Urbana-Champaign.
4. Benekohal, R.F. and Rawls, C. G., "Analyses of the Drivers' Responses in Final Surveys to the In-Vehicle Receiver (IVR), FHWA-IL/UI-TOL-13, March 2004, University of Illinois at Urbana-Champaign.

APPENDIX A

VISUAL MODE ONLY

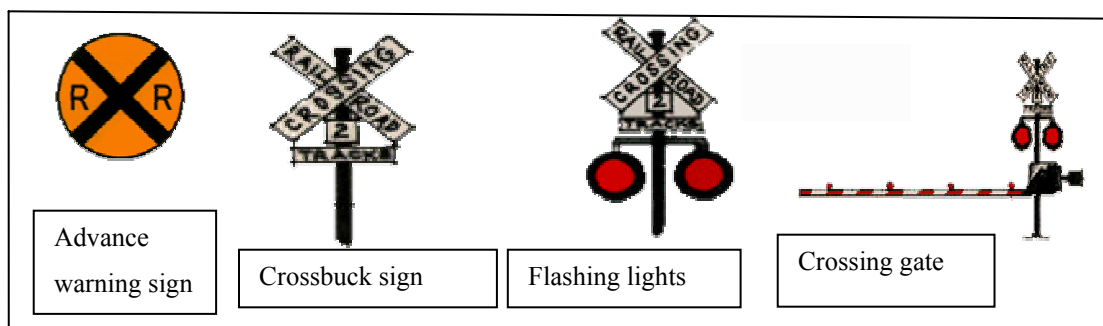
Survey of Professional Drivers' Opinions for Pilot Study of Advisory On-Board Vehicle Warning Systems at Railroad Grade Crossings

Instructions: The University of Illinois at Urbana-Champaign is conducting this survey for IDOT. Your responses will be kept confidential. This survey covers the time period your In-Vehicle Receiver was operating in VISUAL mode only. *PLEASE COMPLETE AND RETURN IN THE ENCLOSED ENVELOPE. THANK YOU FOR YOUR HELP.*

- 1) In the year 2000, how long have you driven a vehicle with the In-Vehicle Receiver?
 a) 1 month b) 2 months c) 3 months 4) Others (specify) _____ months

- 2) Do you use any of the following railroad grade crossings? For a "Yes" response please give frequency.

	<u>Community</u>	<u>Crossing</u>	No	Yes	_____ Times/week
a)	Morton Grove	Beckwith Road/Lehigh Ave	No	Yes	_____ Times/week
b)	Glenview	Chestnut Street/Lehigh Ave	No	Yes	_____ Times/week
c)	Northbrook	Shermer Road	No	Yes	_____ Times/week
d)	Northbrook	Dundee Road (near Waukegan Rd)	No	Yes	_____ Times/week
e)	Deerfield	Greenwood Ave/ Park Ave	No	Yes	_____ Times/week



- 3) For the above five crossings, please rate the effectiveness of the following railroad grade crossing warning devices:

EFFECTIVENESS

	<u>Very High</u>	<u>High</u>	<u>Medium</u>	<u>Low</u>	<u>Very Low</u>	<u>No Opinion</u>
a) Advance warning sign	5	4	3	2	1	0
b) Crossbuck sign	5	4	3	2	1	0
c) Flashing lights	5	4	3	2	1	0
d) Crossing gate	5	4	3	2	1	0
e) Clanging bell	5	4	3	2	1	0
f) Train horn	5	4	3	2	1	0
g) In-Vehicle Receiver	5	4	3	2	1	0

4) Do you trust your In-Vehicle Receiver to give an accurate warning of a train approaching or occupying the equipped crossings in Question 2?

- a) Yes, I trust it very much
- b) Yes, I trust it to some degree
- c) No, I do not trust it
- d) Don't recall/No opinion

5) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in VISUAL mode, have you experienced any problems with the IVR powering on properly?

- a) No
- b) Don't recall/No opinion
- c) Yes, how many times did this occur? _____

6) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in VISUAL mode, how many times has your IVR given you a warning when a train WAS NOT approaching or occupying the equipped crossings in Question 2?

- a) _____ Times
- b) Don't recall/No opinion

7) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in VISUAL mode, how many times has your IVR failed to give you a warning when a train WAS approaching or occupying the equipped crossings in Question 2?

- a) _____ Times
- b) Don't recall/No opinion

8) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in VISUAL mode, what percentage of the time has your IVR provided you a warning when a train WAS approaching or occupying the equipped crossings in Question 2?

- a) _____ Percent of the time
- b) Don't recall/No opinion

9) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in VISUAL mode, has the IVR given you a signal that you did not understand?

- a) No
- b) Don't recall/No opinion
- c) Yes, how many times? _____ Please describe the nature of the signal. _____

10) From the following list of visual distractions, please circle ALL that apply to your daily driving conditions:

- a) Visual distractions from passengers
- b) Exterior light sources
- c) Interior warning lights
- d) Other (please specify) _____



Please mail to:

**Professor R. F. Benekohal
University of Illinois at Urbana-Champaign
205 N. Mathews Ave.
Urbana, Illinois 61801**

AUDIBLE MODE ONLY

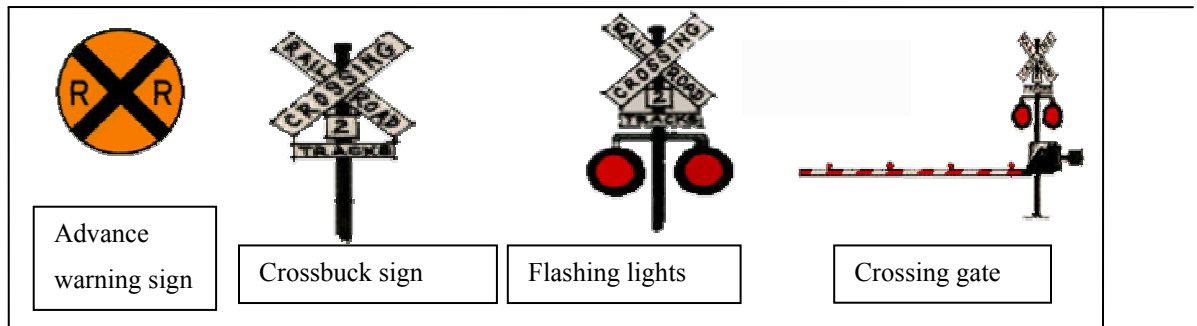
Survey of Professional Drivers' Opinions for Pilot Study of Advisory On-Board Vehicle Warning Systems at Railroad Grade Crossings

Instructions: The University of Illinois at Urbana-Champaign is conducting this survey for IDOT. Your responses will be kept confidential. This survey covers the time period your In-Vehicle Receiver was operating in **AUDIBLE** mode only. *PLEASE COMPLETE AND RETURN IN THE ENCLOSED ENVELOPE. THANK YOU FOR YOUR HELP.*

1. In the year 2000, how long have you driven a vehicle with the In-Vehicle Receiver?
 a) 1 month b) 2 months c) 3 months 4) Others (specify) _____ months

- 2) Do you use any of the following railroad grade crossings? For a "Yes" response please give frequency.

<u>Community</u>	<u>Crossing</u>				
a) Morton Grove	Beckwith Road/Lehigh Ave	No	Yes	_____	Times/week
b) Glenview	Chestnut Street/Lehigh Ave	No	Yes	_____	Times/week
c) Northbrook	Shermer Road	No	Yes	_____	Times/week
d) Northbrook	Dundee Road (near Waukegan Rd)	No	Yes	_____	Times/week
e) Deerfield	Greenwood Ave/ Park Ave	No	Yes	_____	Times/week



- 3) For the above five crossings, please rate the effectiveness of the following railroad grade crossing warning devices:

	EFFECTIVENESS					
	<u>Very High</u>	<u>High</u>	<u>Medium</u>	<u>Low</u>	<u>Very Low</u>	<u>No Opinion</u>
a) Advance warning sign	5	4	3	2	1	0
b) Crossbuck sign	5	4	3	2	1	0
c) Flashing lights	5	4	3	2	1	0
d) Crossing gate	5	4	3	2	1	0
e) Clanging bell	5	4	3	2	1	0
f) Train horn	5	4	3	2	1	0
g) In-Vehicle Receiver	5	4	3	2	1	0

4) Do you trust your In-Vehicle Receiver to give an accurate warning of a train approaching or occupying the equipped crossings in Question 2?

- a) Yes, I trust it very much
- b) Yes, I trust it to some degree
- c) No, I do not trust it
- d) Don't recall/No opinion

5) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in AUDIBLE mode, have you experienced any problems with the IVR powering on properly?

- a) No
- b) Don't recall/No opinion
- c) Yes, how many times did this occur? _____

6) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in AUDIBLE mode, how many times has your IVR given you a warning when a train WAS NOT approaching or occupying the equipped crossings in Question 2?

- a) _____ Times
- b) Don't recall/No opinion

7) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in AUDIBLE mode, how many times has your IVR failed to give you a warning when a train WAS approaching or occupying the equipped crossings in Question 2?

- a) _____ Times
- b) Don't recall/No opinion

8) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in AUDIBLE mode, what percentage of the time has your IVR provided you a warning when a train WAS approaching or occupying the equipped crossings in Question 2?

- a) _____ Percent of the time
- b) Don't recall/No opinion

9) In the past 3 months that your In-Vehicle Receiver (IVR) was operating in AUDIBLE mode, has the IVR given you a signal that you did not understand?

- a) No
- b) Don't recall/No opinion
- c) Yes, how many times? _____ Please describe the nature of the signal. _____

10) From the following list of audible distractions, please circle ALL that apply to your daily driving conditions:

- a) Background noise from radio/tape
- b) Background noise from passengers
- c) Sirens/horns
- d) Loud engine
- e) Other (please specify) _____

Audible Warnings from the In-Vehicle Receiver

11A) How well can you hear the warning tone (beeping sounds) from the In-Vehicle Receiver?

- a) Too soft
- b) Just right
- c) Too loud
- d) No opinion

12A) How is the quality of the warning tone?

- a) Too harsh/piercing
- b) Just right
- c) Too dull/plain
- d) No opinion

13A) How is the length of the warning tone?

- a) Beeps too long
- b) Beeps right length of time
- c) Beeps too short
- d) No opinion

14A) Overall, is the warning tone noticeable from other audible cues you receive while driving?

- a) Yes - the warning tone is noticeable
- b) No - the warning tone is not noticeable
- c) No opinion

15A) How would you rate the overall quality of the audible message you received from your In-Vehicle Receiver?

- a) Excellent b) Good c) Fair d) Poor e) No opinion

16A) Do you have any comments/suggestions _____

THANK YOU VERY MUCH FOR YOUR PARTICIPATION



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