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Review scientific paper

Driver's knowledge of local railway crossing characteristics

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Abstract –**The approach to this research consisted of conducting a questionnaire survey of drivers in Serbia to collect data on perception of motor vehicle drivers at the local railway crossings. The objective of this paper was to investigate the potential factors affecting drivers' knowledge of safely driving at the railway crossings.**

Keywords –**railway crossing, field survey questionnaire, safety**

I. INTRODUCTION

Drivers who are familiar with a crossing have an expectancy about the likelihood of encountering a train at that crossing. If expectancy is low, then the driver who is familiar with the crossing will be less likely to detect a train at that crossing than a driver who is unfamiliar with the crossing or a driver who frequently encounters trains at that crossing (Lerner, et al., 1990), [1]. In fact, railway crossing accidents were committed more frequently by drivers familiar with the area than unfamiliar drivers (Abraham, et al., 1998), [1]. Driver inattention can also be a result of drivers' low expectance of a train. Drivers seem to underestimate the number of train through movements at a crossing. This low expectancy gets reinforced each time a driver passes the crossing without seeing a train and, as a result, can probably relax drivers' vigilance in searching for trains, [2].

Studies showed that drivers' estimates of train volume were based on their familiarity with the area. Consequently, drivers who are familiar with a crossing will be less likely to look for a train at the crossing or to reduce their speed on their approach to the crossing than drivers who are unfamiliar with the crossing, [1].

Drivers' failures to comply at crossing may also be attributable to their biases and attitudes towards compliance and their perception of the dangers at grade crossings. Drivers had low expectancies for encountering a train at a crossing (Dolan, 1996; NTSB, 1998), and some drivers did not even look for a train at a crossing (Åberg, 1988; Wigglesworth, 2001). The low expectation for trains is reinforced each time the driver passes a crossing without meeting a train at that crossing. Consequently, drivers who were familiar with the crossing were involved in more grade crossing incidents than drivers who were not (Abraham, et al., 1998), [1].

The warning time provided at a crossing, or the time available between device activation and train arrival, may also influence a driver's tendency to violate. Credibility of the crossing traffic control devices decreases when the warning time provided is excessive or highly variable. Long warning times at a few crossings can, in fact, decrease credibility of not only the crossing where the excessive warning time was experienced but of all active warning devices, [3].

Train speeds may influence violations at railroad grade crossings. Crossings without constant warning time devices (fixed-distance devices) will produce a variable warning time if the train speed varieties. This variability, as previously discussed, has proven to create credibility problems, thus influencing violations, [3].

A survey questionnaire that asks motor vehicle drivers inattentive driving experiences, knowledge, attitudes, and expectations towards safety at railway crossings can be very useful in explaining inattentive driving behaviors, [4]. Davey et al. (2008) made semi structured focused group interviews to 53 young drivers from a regional and metropolitan settings drivers self/reported behaviors, attitudes, and knowledge at railway crossings were explored, [5].

This research assumed that safety at railway crossings was associated with driver knowledge and behaviors at such site.

II. RESEARCH OBJECTIVES AND HYPOTHESES

The approach to this research consisted of conducting a field questionnaire survey of drivers in Serbia to collect data on perception of drivers at the local railway crossings.

The objectives of this research were to report motor vehicle driver knowledge of safety negotiation at railway crossings.

Using the collected data, the researchers were tested the following hypotheses presented in Table I.

TABLE I
RESEARCH HYPOTHESES

Number	Hypotheses description
1	Drivers' knowledge of a railway crossing warning devices is increases with usage of crossing.
2	Drivers' knowledge of number of trains per day increases with usage of crossing.
3	Drivers' knowledge of the waiting time for a train at a railway crossing is increases with usage of crossing.
4	Drivers' knowledge of the speed of trains at a railway crossing is increases with usage of crossing.
5	Drivers' knowledge of railway crossing may be also related to age, education level and driving experience.

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III. DATA COLLECTION PROCESS

The survey included a sample of 389 field survey questionnaires on 15 railway crossings in different Serbian cities. Local residents were surveyed and 20-30 drivers were surveyed per railway crossing.

IV. DRIVERS' KNOWLEDGE OF LOCAL RAILWAYCROSSING CHARACTERISTICS

A. Characteristics of railway crossings

The survey was conducted at 15 railway crossings, where, 13 are active, one passive and one with a crossing guard.

Four characteristics of railway crossings are presented:

1.Warning devices at the railway crossings, where A is road sign, B is half gates and C is full gates;

2. Actual number of trains per day;

3. Waiting time for a train. Waiting time is the time interval from the moment of activation of the warning devices to the moment a train enters a crossing atthe active crossings. For passive crossings that is the time from the moment a train is spotted until a train arrives at the crossing;

4. Maximal train speed at a given crossing according to timetable.

Table II presented characteristics of railway crossings.

TABLE II
CHARACTERISTICS OF RAILWAY CROSSINGS

Characteristics of railway crossings				
No. crossing	Warning devices	Number of trains per day	Waiting time (min)	Trains speed (km/h)
1	C	14	>2	60
2	B	14	>2	60
3	A	14	<2	60
4	B	8	1	60
5	B	40	1	80
6	B	40	1	80
7	B	30	1	90
8	B	40	1	80
9	B	40	1	80
10	B	26	>2	50
11	B	12	>2	30
12	B	15	>2	50
13	B	15	>2	80
14	B	35	>2	30
15	B	35	>2	30

On Figs 1, 2 and 3 pictures of railway crossings are presented.

Fig. 1. Railway crossing no. 3,on the km162+593 rail (Niš)-Crveni Krst-Zaječar-Prahovo pristanište

Fig. 2. Railway crossing no. 7, on the km 32+022 rail (Beograd Centar)-Resnik-Požega-Vrbnica-državna granica-(BijeloPolje)

Fig. 3. Railway crossing no. 1, on the km 174+510 rail (Niš)-Crveni Krst-Zaječar-Prahovo pristanište

B. *Frequency of use of railway crossings by drivers*

That first question was: “Which railway crossing in your place do you use most often?”.

The second question will be explained in the section C of the paper.

The third question concerns the frequency of use local railway crossing. Drivers are offered the following answers: - I use every day and how many times a day, - I use once or more times a week, - I use once or more times a month.

Table III show a summary of the use frequency of the railway crossings.

TABLE III
USE FREQUENCY OF THE RAILWAY CROSSINGS (IN PERCENTAGE %)

Use frequency of the rail crossings (in percentage %)				
No. crossing	Every day	Once a week	More times a week	Once or more times a month
1	63	10	23	4
2	54	23	23	0
3	40	37	23	0
4	34	13	53	0
5	28	28	44	0
6	28	16	40	16
7	17	33	50	0
8	56	20	20	4
9	64	12	20	4
10	50	5	40	5
11	53	4	43	0
12	50	27	23	0
13	48	26	23	3
14	24	24	43	9
15	87	0	13	0

The use of road crossings by surveyed drivers varies depending on the road crossing. Compared to the total number of drivers surveyed, an average of 45% use the road crossing once or more times. Once a week, several times a week, or once and several times a month, the average crossing is used by 55% of drivers surveyed.

C. *Level of knowledge of drivers crossing the railway crossing every day*

Questions 2 and 4-7 are intended to test the driver's knowledge of the characteristics of local railway crossings. Question 2 concerns driver knowledge of a crossing warning device at the local crossing. Questions 4 is related to the driver's observation of daily numberof trains at these railway crossings and also is related to the expectation of encountering trains. Questions 5 and 6 are related to the estimate of waiting time. Question 5 refers to active crossings and question 6 to passive crossings. Question 7 is related to the driver's assessment of a train speed.

Table IV presents the summary overview of the responses of drivers crossing the railway crossings every day to 4 selected questions.

TABLE IV
KNOWLEDGE OF DRIVERS CROSSING THE RAILWAY CROSSINGS EVERY DAY ABOUT THE CHARACTERISTICS OF RAILWAY CROSSINGS (IN PERCENTAGE %)

No. crossing	Crossing warning devices	Daily number of trains	Waiting time	Trains speed
1	95	63	84	0
2	100	75	100	0
3	100	100	33	0
4	100	60	50	30
5	100	15	29	71
6	100	15	29	0
7	100	0	0	60
8	93	7	43	21
9	94	13	13	0
10	100	70	100	80
11	82	27	82	100
12	100	33	100	100
13	100	40	80	0
14	100	20	60	100
15	42	0	17	100

Most drivers (93%) have the knowledge of railway crossing warning devices.

40% of the total number of surveyed drivers crossing the crossings daily accurately or approximately correctly estimated how many trains pass daily over the crossings.

60% of drivers crossing daily the railway crossings had a good estimate of the waiting time for the train from the moment of signaling, ie. from the moment the train is spotted until it arrives at the crossing.

Train speeds were well estimated by 37% of drivers.

D. *Level of knowledge of drivers' who crossing once or more times a week and once or more times a month*

Table V presents the summary overview of the responses of drivers crossing the railway crossings once or more times a week and once or more times a month to 4 selected questions.

Majority of drivers (98%) know which warning devices are implemented at railway crossing.

Of the total number of surveyed drivers who do not cross the crossings daily, 25% of them accurately or approximately accurately estimated how many trains pass daily through the crossings.

Waiting time for the train from the moment of signaling, ie. from the moment the train is spotted until it arrives at the crossing, 51% of drivers who do not cross the crossings every day have evaluated it well.

Train speeds were well estimated by 37% of drivers.

TABLE V
KNOWLEDGE OF DRIVERS CROSSING THE RAILWAY CROSSINGS ONCE OR MORE TIMES ON WEEK AND ONCE OR MORE TIMES A MONTH ABOUT THE CHARACTERISTICS OF RAILWAY CROSSINGS (IN PERCENTAGE %)

No. crossing	Crossing warning devices	Daily number of trains	Waiting time	Trains speed
1	100	36	73	9
2	100	64	64	0
3	100	39	50	0
4	100	80	35	15
5	100	33	44	44
6	94	5	45	0
7	96	0	8	64
8	82	18	55	0
9	100	0	56	22
10	100	60	60	50
11	90	0	80	90
12	100	13	93	100
13	100	0	19	0
14	100	6	81	100
15	100	0	100	100

E. Comparison of frequency of use of railway crossings and knowledge of the drivers of its characteristics

Figure 4 shows a comparative analysis of the knowledge of railway crossing characteristics for the two groups of drivers surveyed.

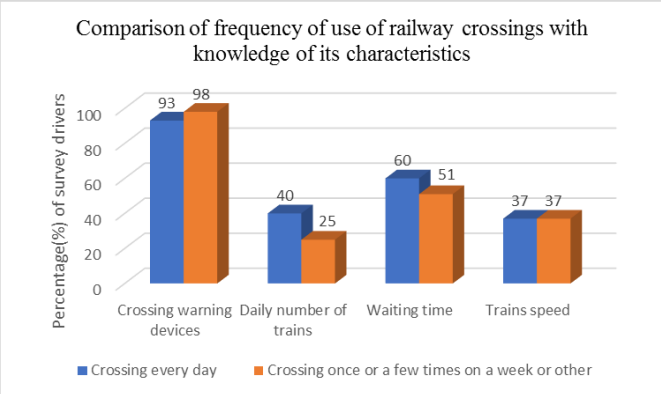

Fig. 4. Comparison of frequency of use of railway crossings and knowledge of the drivers of its characteristics

These results have shown that there is no major difference between the knowledge of drivers crossing daily and others regarding the knowledge of the crossing warning devices. This does not confirm hypothesis 1 in Table I. Namely, their knowledge of crossing warning devices at the railway crossings has been shown are satisfactory.

The difference in the estimated daily number of trains by drivers crossing daily and those crossing occasionally is considerable.

Therefore, Hypothesis 2 states that drivers' knowledge of number of trains per day increases with usage of crossing has been confirmed. This shows that their knowledge about the daily number of trains is not satisfactory.

Futhermore, the hypothesis 3 that drivers' knowledge of the waiting time for a train at a railway crossings is increased with usage of crossing is confirmed.Specifically, drivers who use the daily crossing have a better estimate of the waiting time for the train than other drivers.

The estimation of trains speed is not satisfactory for both groups of drivers and is inconsistent with the hypothesis 4 that drivers' knowledge of the speed of trains at a railway crossing is increases with using of crossings.

V. CONCLUSION

Frequency of use of the railway crossing can be a potential factor affecting inattentive driver behaviour. According to [3], drivers who used railway crossing frequently (i.e., *≥ 2* times/day) and familiar with local railway crossing were more likely to involve in distracted driving behaviours at railway crossings.

Drivers who are familiar with a crossing have expectancy about the likelihood of encountering a train at that crossing, [2]. This research showed that drivers do not have a good perception of the daily number of trains.

The warning time provided at a crossing, or the time available between device activation and train arrival, may also influence a driver's tendency to violate, [3]. Drivers' knowledge of the waiting time for a train at a railway crossing is satisfactory.

Train speeds may influence violations at a railway crossing, [3]. It is shown that the drivers' perception of train speed at a railway crossings is very poor.

Drivers' knowledge of railway crossings characteristics may be also related to age, education level and driving experience, with will be the subject further research.

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