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Drivers' Comprehension of the Traffic Signs

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Abstract: ***Effectiveness of a traffic sign is greatly influenced by design and non-design factors. The non-design factors are influenced, among other things, by drivers' driving skills and comprehension of the meaning of such signs. Questionnaires distributed to a total of 202 respondents who have obtained driver's license and are domiciled in Soloraya region. These questionnaires examine these respondents' comprehension of the existing 15 traffic signs. Based on the response provided by the respondents, it is revealed that 67% of the respondents has the correct comprehension of the traffic signs meaning. The F-test indicates that the variables of age, sex, education, occupation, type of driver's license owned and the length of time driver's license simultaneously bring a significant effect on the obtained score for the respondents' comprehension, but only the variable of the type of driver's license owned which partially has a significant effect on the respondents' comprehension of the traffic signs.***

Keywords: Driver, comprehension, types of driver's license owned

1. Introduction

Traffic signs are parts of road equipment in the form of symbols, letters, numbers, sentences, or a combination of them which serve as a warning, regulatory, command or guide for road users. Warning signs are signs used to express a warning of hazard or dangerous places on the road ahead of the road users. Regulatory signs are signs used to specify any actions which road users are not allowed to do. Command signs are signs used to express a command which must be done by road users. Guide signs are signs used to provide directions, roads, situations, places, facility arrangements and the like to road users [1].

Information about the hazard to drivers can be done by providing a variety of warning signs on the roadside. However, various experimental studies have questioned the effectiveness of warning signs [2]-[3]. Traffic signs are deemed effective if they manage to communicate the message they carry to road users [4]-[5]. Also, their effectiveness is also determined by the characteristics of various situations, people and the warning signs it self [6]. In so doing, generally traffic signs may function effectively because of the effects arising from non-design and design factors [7]. The non-design factors refer to factors associated with humans who see the warning signs, such as drivers' comprehension of the traffic signs [8]-[9]-[6]-[5]-[11]-[13]. In addition to the design and non-design factors, effectiveness of traffic signs also depends on the driving ability or skill and experience. It is influenced by a number of factors such as the age of a driver [14], the type of driver's license owned, the length of time a driver has obtained driver's license, the type of vehicle usually used, the range and frequency of driving a vehicle, as well as the average mileage per day [8]-[9]-[13]-[10]-[11].

A study in the Northern Ethiopian city of Mekele [13] indicates that there is only 50 – 60% of drivers who can correctly identify warning signs. In accordance with this study, education background, sex, monthly income and ethnicity or nationality of the drivers turn out to significantly influence their comprehension of traffic signs.

The other study concerning the comprehension of 42 traffic signs consisting of 20 command signs, 17 warning signs and 5 direction signs shown to 202 drivers in Dhaka City, Bangladesh [11] suggests that the drivers' comprehension of the regulatory signs, warning signs and direction signs is 49%, 52% and 55%, respectively.

Another study [15] examine the comprehension of 10 traffic signs, among other things, indicates that of the traffic signs, 5 of them were answered correctly by a majority of respondents, namely "intersection ahead". The "pedestrian crossing" traffic sign was answered correctly by 347 respondents (99%). The "no entry" traffic sign was answered correctly by 349 respondents (99.7%). The "maximum speed of 35 km per hour" traffic sign was answered correctly by 307 respondents (87.7%). The "stop and give way" traffic sign was answered correctly by 346 respondents (98.9%). About half of the respondents (50.6%) or 177 respondents were able to answer the "no overtaking for cars" traffic sign correctly. The overall score for the comprehension of traffic signs indicates that 189 respondents (54%) have a high comprehension, 61 respondents (17.4%) have a moderate comprehension and 100 respondents (28.6%) have poor comprehension.

Drivers' comprehension of the traffic signs is a serious problem. There are many studies in various countries that test drivers' comprehension of the signs in the city of Dhaka, Bangladesh [11], in the city of Mekele, Ethiopia [15] and the UAE [13]. There is poor reference or study of drivers' comprehension on traffic signs in Indonesia. Therefore, this study tries to explore how understanding the drivers of the traffic signs in the country of Indonesia, especially in the Soloraya area.

2. Research Methodology

The research sample or respondents to examine were selected using the probabilty sampling technique using the non-proportional stratified sampling consisting of vehicle users who have obtained a driver's license and are domiciled in Soloraya area. Soloraya is an area in Central Java province, Indonesia. Its territory includes the cities Surakarta, Sukoharjo Regency, Boyolali Regency, Klaten Regency, Wonogiri Regency, Karanganyar Regency, and Sragen Regency.

Type of driver's license owned in Indonesia country were classified into some groups. C driver's license to drive a motorcycle. A driver's license to drive a passenger car and heavy goods by the number of individuals who are allowed not exceed 2,500 kg. A public driver's license to drive public vehicles and goods with the amount of weight does not exceed 3,500 kg permissible. B1 driver's license, for driving a private passenger and goods with the amount of weight that allowed more than 3,500 kg. B1 public driver's license to drive passenger cars and general merchandise to the amount of weight that allowed more than 3,500 kg. B2 driver's license to drive a heavy vehicle, towing vehicle, or motor vehicle by pulling the buggy patch or an individual with a heavy trailer is allowed for trains patches or tow more than 1,000 kg. B2 public to steer the towing vehicle or motor vehicle by pulling the buggy patch or a trailer with a weight that is allowed for trains patches or tow more than 1,000 kg.

Furthermore, a survey was conducted by distributing questionnaires to 202 respondents. The survey was conducted to examine the drivers' comprehension of 15 existing traffic signs, consisting of 5 warning signs, 5 regulatory signs and 5 command signs. The questionnaires consisted of two sections, the first one was a written section and the second one was to be filled by selecting an answer. The first section the respondents to provide information such as their name, date of birth, address, sex, latest education, while the second section requires the respondents to select options related to the type of driver's license, the length of time a driver has obtained driver's license and the mileage per day.

In term of the age or date of birth, the respondents were grouped into the age groups of 53-64 years old, 41-52 years old, 29-40 years old and 17-28 years old. In terms of sex, the respondents were grouped into male and female. In terms of the latest education, the respondents were grouped into university graduates (undergraduate program, master program or doctoral program), D-III program graduates, senior high school graduates and elementary school/junior high school graduates. In relation to the current occupation, the respondents were grouped into a truck/bus/taxy driver, civil servant/soldier/police, private employee, enterpreneur and student/college student. The drivers' experience and mileage travelled per day were grouped into the mileage per day by > 200 Km, 101-200 Km, 51-100 Km, 31-50 Km and < 30 Km. The type of driver's license owned was classified into driver's license C, driver's license A and driver's license A public, driver's license B1 and driver's license B1 public, as well as driver's license B2 and driver's license B2 public. As for the length of time a driver has obtained driver's license which also indicates the driving experience, it was classified into > 10 years, 6-10 years, 1-5 years and <1 year. The score for the drivers' comprehension of the traffic signs was determined by the accuracy of the respondents in defining the meaning of the traffic signs presented in the questionnaire sheets as shown in Figure 1.

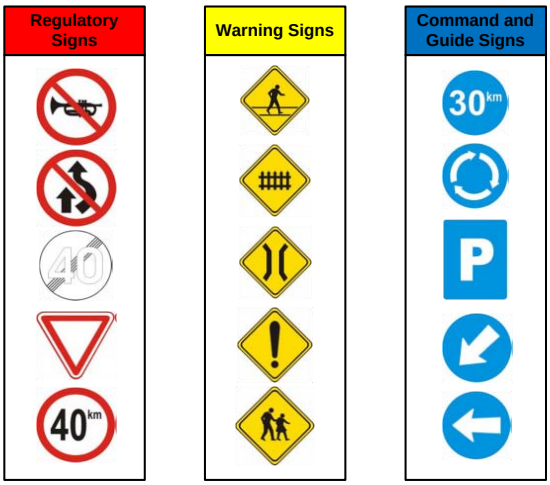

Figure 1: Types of the Traffic Signs in The Second Section Tested

3. Data Analysis and Results

Results for the answers to the questionnaires filled in writing by 202 respondents relating to their comprehension of the existing 15 traffic signs are presented in Table 1. The table is sorted in descending order by the highest to lowest drivers' comprehension. Based on the table, the average comprehension of the respondents with regard to the 15 traffic signs tested is equal to 67%, where the sign with the highest percentage of respondents comprehension it is the "parking lot" sign, i.e. by 98% and the sign with the lowest percentage of respondents comprehension it is the "minimum speed allowed" sign, i.e. by 20%.

Table 1: Results for the Respondents' Comprehension of the Traffic Signs

Symbol	*Traffic Sign Meaning*	*Percentage*	*Result compare with [11]*
	Parking lot	98%	56%
	A bridge or the road narrows on the bridge	96%	49%
	Prohibition to use any sound signaling	96%	83%
	Be careful	93%	NA
	It is compulsory to follow the direction specified on the roundabout	89%	NA
	Level crossing with the barrier-equipped railroad line	87%	62%
	No overtaking	82%	82%

Symbol	*Traffic Sign Meaning*	*Percentage*	*Result compare with [11]*
	Zebra crossing	72%	86%
	Turn left	69%	21%
	The lane or road section that must be passed	65%	24%
	The maximum speed is 40 km per hour and any vehicles are not allowed to travel at a speed of faster than it	56%	27%
	Many children	36%	NA
	Prohibition to continue moving if it causes hindrances, obstacles, disruption for traffic from the other direction that must take precedence	27%	33%
	The end of the maximum speed is 40 km/ hour	24%	35%
	Minimum speed allowed	20%	NA

The analysis to determine the drivers' comprehension of the traffic signs was made using the multiple regression analysis. Drivers' comprehension of the traffic signs was the dependendent variable anda the length of time a driver has obtained driver's license, education background, sex, mileage, type of driver's license, age, and occupation were the independent variables.

The comprehension score contribution of each variable is presented in Table 2 and the correlation for the variable of the respondents' comprehension score was carried out using the F-test, while the correlation among the variables was carried out using the t-test. The details are presented in Tables 3, 4 and 5.

Table 2: The Model Summary

Model	*R*	*R Square*	*Adjusted R Square*	*Std. Error of the Estimate*
1	.461[a]	.212	.184	2.037

a. Predictors: (Constant), the Length of Time a Driver Has Obtained driver's license , Education Background, Sex, Mileage, Type of driver's license, Age, Occupation

Based on Table 2 above, the R Square score is equal to 21%, meaning that 21% of respondents' comprehension score can be explained or influenced by variables of age, sex, education background, mileage, type of driver's license owned and the the length of time a driver has obtained driver's license. The remaining 89% is influenced by other variables excluding those variables.

Table 3: Anova

Model		*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
1	Regression	216.932	7	30.990	7.468	.000[a]
	Residual	805.088	194	4.150		
	Total	1022.020	201			

a. Predictors: (Constant), the Length of Time a Driver Has Obtained driver's license , Education Background, Sex, Mileage, Type of driver's license , Age, Occupation
b. Dependent Variable: the Score for the Comprehension of the Traffic Signs

Based on the testing results of the F-value in Table 3 above, the significance value is equal to 0.000 or <0.05. This shows that the variables of the length of time a driver has obtained driver's license, education background, sex and mileage per day simultaneously affect significantly the respondents' score for the comprehension of the existing traffic signs.

The testing results for t-values in Table 3 generate different significance values. The effect of the type of driver's license owned has a significance value by 0.000 or <0.05. This indicates that the variable of the ownership of driver's license C, driver's license A and driver's license A public, driver's license B1 and driver's license B1 public, as well as driver's license B2 and driver's license B2 public partially has a significant influence on the score for the comprehension of the existing traffic signs. As for the variables of age, sex, education background, mileage and the length of time a driver has obtained driver's license partially show a significant impact on the comprehension of the traffic signs.

Table 4: The Collinearity Coefficient

Model		*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*	*Collinearity Statistics*	
		B	*Std. Error*	*Beta*			*Tolerance*	*VIF*
1	(Constant)	6.899	.868		7.951	.000		
	Age	.050	.187	.021	.269	.788	.638	1.568
	Sex	.165	.355	.032	.466	.641	.854	1.171
	Education Background	.045	.160	.019	.281	.779	.883	1.132
	Occupation	.054	.162	.027	.333	.739	.610	1.639
	Mileage	.262	.135	.135	1.943	.053	.840	1.191
	Type of driver's license	.874	.211	.331	4.143	.000	.637	1.570
	The Length of Time Driver's License	.199	.181	.087	1.099	.273	.651	1.535

a. Dependent Variable: the Score for the Comprehension of the Traffic Signs

Results of the multicolinierity test as shown in Table 5 suggest that the tolerance score of each variable is > 0.1 and all the VIF scores are <10. This indicates that multicolinierity is not found in each independent variable or a linear or perfect relationship among the variables of age, sex, education background, mileage, type of driver's license owned and the length of time a driver has obtained driver's license which determine the respondents' score for the comprehension of the existing traffic signs is absent.

The strength of the relationship among the variables can be determined based on the value of Pearson correlation where in general the Pearson correlation score by less than 0.25 is considered to have a weak correlation, the Pearson correlation score ranging from 0.25 to 0.50 is considered to have a moderate correlation and the Pearson correlation score ranging from 0.50 to 0.75 is considered to have a strong correlation. The relationship between the comprehension score has a moderate correlation with the variables of occupation, mileage and type of driver's license owned and a weak correlation with the variables of age, sex, education background and length of time a driver has obtained driver's license . As for the type of driver's license owned by a driver, it has a very strong correlation with the type of occupation, and a moderate correlation with the drivers' score for their comprehension of the traffic signs, their age, their sex, the mileage they travelled and length of time they have obtained driver's license.

Place table titles above the tables.

Table 5: Collinearity Testing

		Score for the Comprehension of the Traffic Signs	Age	Sex	Education Background	Occupation	Mileage	Type of Driver's License	The Length of Time Driver's License
Score for the Comprehension of the Traffic Signs	Pearson Correlation	1	.227**	.187**	-.080	.287**	.263**	.423**	.225**
	Sig. (2-tailed)		.001	.008	.257	.000	.000	.000	.001
	N	202	202	202	202	202	202	202	202
Age	Pearson Correlation	.227**	1	.225**	.002	.424**	.129	.370**	.536**
	Sig. (2-tailed)	.001		.001	.978	.000	.068	.000	.000
	N	202	202	202	202	202	202	202	202
Sex	Pearson Correlation	.187**	.225**	1	-.191**	.250**	.197**	.313**	.193**
	Sig. (2-tailed)	.008	.001		.006	.000	.005	.000	.006
	N	202	202	202	202	202	202	202	202
Education Background	Pearson Correlation	-.080	.002	-.191**	1	-.012	-.245**	-.192**	.046
	Sig. (2-tailed)	.257	.978	.006		.865	.000	.006	.512
	N	202	202	202	202	202	202	202	202
Occupation	Pearson Correlation	.287**	.424**	.250**	-.012	1	.263**	.514**	.435**
	Sig. (2-tailed)	.000	.000	.000	.865		.000	.000	.000
	N	202	202	202	202	202	202	202	202
Mileage	Pearson Correlation	.263**	.129	.197**	-.245**	.263**	1	.310**	.163*
	Sig. (2-tailed)	.000	.068	.005	.000	.000		.000	.020
	N	202	202	202	202	202	202	202	202
Type of driver's license	Pearson Correlation	.423**	.370**	.313**	-.192**	.514**	.310**	1	.258**
	Sig. (2-tailed)	.000	.000	.000	.006	.000	.000		.000
	N	202	202	202	202	202	202	202	202
The Length of Time a driver's license	Pearson Correlation	.225**	.536**	.193**	.046	.435**	.163*	.258**	1
	Sig. (2-tailed)	.001	.000	.006	.512	.000	.020	.000	
	N	202	202	202	202	202	202	202	202

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

4. Conclusions

Overall, the comprehension of the 15 traffic signs of the 202 respondents in Soloraya area, Central Java Province is equal to 67%. This is better the comprehension of traffic signs investigated in the previous research in Dhaka, Bangladesh, i.e. by 50% [11] and in countries situated in desert areas (Quwait, Oman, Qatar, UAE and Bahrain), i.e. by 56% [13]. Likewise, the finding of this research is also better compared with the percentage of the comprehension of traffic signs in the Northern Ethiopian city of Mekele, i.e. by 17.4% to 54% [15].

Based on the above data analysis, it is evident that the type of driver's license owned has a significant effect on the drivers' comprehension of the existing traffic signs. This suggests that owners of driver's license B2 and B2 Public and owners of driver's license B1 and B1 Public have a better comprehension of the traffic signs compared with the owners of C or A and A Public driver's license. Similarly, there is a strong correlation between the type of driver's license owned and occupation. It can be explained that the owners of driver's license B2 and B2 Public and owners of driver's license B1 and B1 Public who generally work as a truck, bus or taxi driver have a better comprehension of the traffic signs compared with the owners of driver's license C or driver's license A and A Public who generally are a driver but does not work as a driver.

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