

**A PRELIMINARY STUDY OF THE MEASUREMENT OF ROAD
WARNING SIGN EFFECTIVENESS IN DKI JAKARTA
ACCORDING TO COMPREHENSION LEVEL**

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ABSTRAK

Paper ini bertujuan untuk menyajikan hasil kajian awal mengenai pengukuran tingkat efektivitas rambu peringatan jalan raya Jakarta berdasarkan survei kepada para pengendara. Dalam kajian awal ini, diambil responden sebanyak 100 orang pengendara yang berdomisili di daerah Jabodetabek. Sebanyak 37 rambu lalu lintas yang digolongkan sebagai rambu peringatan (*warning signs*) diukur efektivitasnya dengan indikator nilai comprehension level sesuai dengan standar ISO 3684. Satu set kuesioner berisi 37 pertanyaan mengenai efektivitas rambu lalu lintas disebarkan kepada 100 pengendara. Nilai comprehension level untuk masing-masing rambu lalu lintas peroleh dengan menghitung persentase jumlah jawaban yang benar untuk masing-masing rambu. Hasil kajian pendahuluan ini menunjukkan bahwa nilai *comprehension level* sebanyak 22 dari 37 rambu peringatan berada di bawah 67%, sebagaimana acuan standar yang diberikan oleh ISO 3684. Kajian awal ini menunjukkan bahwa sebagai besar rambu lalu lintas di DKI Jakarta belum efektif untuk menyampaikan pesan peringatan (*warning*) bagi pengendara bermotor.

Kata kunci: Rambu peringatan, *comprehension level*, efektivitas, ISO 3684

INTRODUCTION

In general, road signs or traffic signs provide information and give instruction for road users such as cyclists, motorcyclists and car driver. Road signs are one of the most common devices for controlling traffic because they can be used to regulate, warn, and guide road users (Ben-Bassat and Shinar, 2006). Road signs play important role in traffic safety for drivers. In particular, the use of road warning signs as an instrument to regulate, warn, and inform road users has become a widely-accepted

notion to maintain highway safety (Shinar et al., 2003; Bazire and Tijus, 2009). Considering this, it is important to provide road users with effectively and easily understood road warning signs.

A few prior studies demonstrated that many road signs were not easily understood by road users as indicated by low comprehension score. A study by Al-Madani and Al-Janahi (2002) in five Middle East countries, drivers only understood 55% of the 28 traffic signs presented to them. Makinde and Oluwasegunfunmi (2014) investigated the understanding of road warning signs in Nigerian cities, resulting in a low comprehension level of 63.00% on the evaluated road warning signs. Recent study by Choocharukula and Sriroongvikrai (2017) among international road users found the comprehension level of 56.00% on the road signs. Similarly, Banares et al. (2018) found that participants did not pass 21 out of 40 Philippines road signs for the standard comprehension level.

Correct understanding is a major factor in determining the effectiveness of road warning signs (Banares et al., 2018). Lack of understanding for warning sign could lead to decision errors while driving. Moreover, it could lead to the occurrence of traffic accidents. In the field of traffic engineering and cognitive ergonomics, one definite measure of the effectiveness of road warning signs is through drivers' comprehension (Makinde and Oluwasegunfunmi, 2014). To aid in the evaluation of effective road warning signs, International Standard Organization (ISO) has set a standard. According to ISO 3864, signs are considered acceptable when a level of at least 67.00% accuracy is obtained in a comprehension test (Brucal et al., 2015).

In *Daerah Khusus Ibukota (DKI) Jakarta*, vehicle traffic tends to increase and become more congested. The number of vehicles from year to year were experiencing an upward trend. With the trend of an increase in vehicle ownership from year to year, certainly it can be said that road factors and traffic signs are among the factors that play important role for driver safety. In addition, it should also be noted that drivers from Bogor, Depok, Tangerang, and Bekasi who occasionally have activities in DKI Jakarta also have an important role in traffic congestion.

The aim of this study is to evaluate the effectiveness of road warning signs in Jakarta, Indonesia. As for preliminary study, 100 drivers were involved in the warning signs test. For the effectiveness criteria, a 67.0 % as standard set by ISO 3864 was used for comprehension level.

METHODOLOGY

In this preliminary study, a number of 100 drivers was participated. They resided in Jabodetabek area (Jakarta, Bogor, Depok, Tangerang, and Bekasi) who are regularly

driving at least one day in a week and at least once in *Daerah Khusus Ibukota (DKI) Jakarta*. Their ages are ranging from 17 to 45 years old.






































In this study, 37 warning signs were evaluated by measuring their comprehension level. Warning signs are used to warn if there may be danger on the road or dangerous place on the road and to inform riders about the nature of the hazard (Ministry of Transportation Republic of Indonesia, 2014). The road warning signs were grouped in to three categories, *the warning signs for hazardous road condition, change in horizontal alignment and change in vertical alignment condition*. These signs and their grouping were presented in Table 1. During the survey, the participants were asked about their understanding for each of the warning signs. To measure the effectiveness of warning signs, comprehension score for each sign was calculated. Comprehension score is used to express the level of understanding of drivers on the warning signs presented. Comprehension scores were percentage of signs answered correctly (Al-Madani & Al-Janahi, 2002). In this study, the level of comprehension is measured by calculating the ratio of the total respondents' correct answers to each sign with the total number of respondents.

To measure the comprehension level of 37 warning signs, a set of questionnaire was distributed distributed to the participants using google forms. The questionnaire was designed to measure the comprehension level for each warning sign. Each question corresponds to one evaluated road warning sign. For each question about warning sign, the participants were asked to answer one out of four options. The responses are coded according to the previous studies (Ben-Bassat and Shinar, 2006; Banares et al., 2018) which are (1) correct and complete, (2) partially correct, (3) incorrect, and (4) the opposite of true sign meaning. Once the questionnaire filled out by drivers, the comprehension score for each warning sign was computed. The comprehension scores were obtained by calculating the percentage of signs answered correctly by participants

(Al-Madani and Al-Janahi, 2002) – see Equation (1). Hence, the results were a list of road warning signs and their comprehension level. Using this list, warning signs which pass or did not pass the 67% standard according to ISO 3864 were established.

$$\text{Comprehension score of warning sign } n_i = \frac{\text{number of correct answer of warning sign } n_i}{\text{number of participants}} \times 100\% \quad \dots \text{ (Equation. 1)}$$

Table 1. Signs and Their Grouping in This Study

Sign No.	Picture	Sign group	Sign No.	Picture	Sign group	Sign No.	Picture	Sign group
1		Hazardous Road Condition	14		Change in Vertical Alignment Condition	27		Hazardous Road Condition
2		Change in Horizontal Alignment Condition	15		Change in Horizontal Alignment Condition	28		Change in Horizontal Alignment Condition
3		Change in Horizontal Alignment Condition	16		Change in Vertical Alignment Condition	29		Change in Horizontal Alignment Condition
4		Hazardous Road Condition	17		Change in Horizontal Alignment Condition	30		Change in Horizontal Alignment Condition
5		Change in Vertical Alignment Condition	18		Change in Vertical Alignment Condition	31		Change in Vertical Alignment Condition
6		Hazardous Road Condition	19		Change in Horizontal Alignment Condition	32		Change in Horizontal Alignment Condition
7		Change in Horizontal Alignment Condition	20		Change in Horizontal Alignment Condition	33		Change in Horizontal Alignment Condition
8		Change in Horizontal Alignment Condition	21		Hazardous Road Condition	34		Hazardous Road Condition
9		Change in Horizontal Alignment Condition	22		Change in Horizontal Alignment Condition	35		Hazardous Road Condition
10		Change in Horizontal Alignment Condition	23		Change in Horizontal Alignment Condition	36		Change in Horizontal Alignment Condition
11		Change in Horizontal Alignment Condition	24		Hazardous Road Condition	37		Change in Horizontal Alignment Condition
12		Change in Horizontal Alignment Condition	25		Hazardous Road Condition			
13		Change in Horizontal Alignment	26		Hazardous Road Condition			

Condition

RESULTS AND DISCUSSION

The responses from warning signs test accomplished by 100 respondents were aggregated and presented in Table 2. To calculate the comprehension score, Equation (1) was used in which only the correct number of each sign is considered (Banares et al., 2018; Ben-Bassat and Shinar, 2015). For example the sign number 1, 53 out of 100 participants answered correctly; this corresponds to 53% comprehension score. Therefore, Table 2 presents the comprehension score for each 37 warning signs from 100 participants. The comprehension level are ranging from 15% (the lowest) to 95% (the highest). Regarding Table 2, among 37 road warning signs in Jakarta evaluated in this study, 22 of which did not pass the 67.0% standard set by ISO 3864. Two of them are very close to 67.0% standard (Sign no.3 and 19 with comprehension score 66.0%)

Considering that 22 out of 37 road warning signs have comprehension score below 67.0%, it is clear that road warning signs in Jakarta are not easily understood by drivers. It is not surprising since similar findings were also found in prior studies (Banares et al., 2018; Choocharukula and Sriroongvikrai, 2017; Yuan et al., 2014; Sodikin et al., 2013; Kirmizioglu and Hasan, 2009; Al-Madani and Al-Janahi, 2002). A low comprehension level, as results of this study, signified that road warning signs in Jakarta are not sufficiently reliable as designed. Regarding findings in this study (low comprehension level), we agreed with Banares et al. (2018) who stated that with low comprehension level, road signs become a mere display rather than an informative tool to control traffic flow as well as to warn motorists of hazards.

Findings in this study that most warning signs were not well understood by drivers need to be addressed by the authority, particularly safety issues. The authority used those not only to regulate and inform but also to warn road users about highway safety. According to Banares et al. (2018), safety in the road environment is dictated by the effectiveness of road warning signs in terms of comprehensibility.

When comprehension level of road warning signs is known to be below the standard set, the goal is to accordingly increase such level then follows (Banares et al., 2018). Regarding the results of comprehension level in this preliminary study, 22 out of 37 warning signs are recommended to be redesigned. In particular, sign number 3 and 19 have 66 % comprehension score, very close to standard set 67% so that the recommendation should be treated in caution.

Considering that this is a preliminary study results, the comprehension level could be different if more samples to be taken. The study is still in progress by involving more samples. However, results in this study signified that road warning signs in Jakarta are not sufficiently reliable as designed – as indicated by low comprehension level for 22 out of 37 warning signs. Regarding results of the study, road warning signs with low comprehension level are recommended to be redesigned.

Table 2.
The Comprehension Level of 37 Evaluated Road Warning Signs and Their Standard According to ISO 3864

Sign No.	Correct answer	Comprehension Level (%)	According to ISO Standard 3864
1	53	53%	Under standard
2	65	65%	Under standard
3	66	66%	Under standard
4	58	58%	Under standard
5	38	38%	Under standard
6	69	69%	
7	55	55%	Under standard
8	51	51%	Under standard
9	72	72%	
10	80	80%	
11	94	94%	
12	54	54%	Under standard
13	69	69%	
14	15	15%	Under standard
15	69	69%	
16	20	20%	Under standard
17	30	30%	Under standard
18	83	83%	
19	66	66%	Under standard
20	64	64%	Under standard
21	32	32%	Under standard
22	18	18%	Under standard
23	78	78%	
24	51	51%	Under standard
25	90	90%	
26	81	81%	
27	54	54%	Under standard

28	94	94%	
29	47	47%	Under standard
30	62	62%	Under standard
31	93	93%	
32	70	70%	
33	60	60%	Under standard
34	55	55%	Under standard
35	29	29%	Under standard
36	77	77%	
37	67	67%	

CONCLUSIONS

This is a preliminary results of the study which aimed to determine the effectiveness of warning sign in DKI Jakarta in term of comprehension level. The comprehension level are ranging from 15% to 94%. The results revealed that among 37 road warning signs in DKI Jakarta, 22 of which did not pass the 67.0% standard set by ISO 3864. Results in this study signified that road warning signs in Jakarta are not sufficiently reliable as designed. Considering this, 22 out of 37 warning signs are recommended to be redesigned. The

It is important to highlight that in this preliminary study, number of participants were only 100 drivers. With millions of drivers traveling in Jabodetabeka area, this study needs more samples to be representative. Currently, this study is still in progress with more samples are going to be involved. Research scope will also be expanded by redesigning the road warning signs with low comprehension level. The redesign will consider the principles of compatibility physically and conceptually, familiarity and standardization (Ben-Bassat and Shinar, 2006). The newly design of road warning signs hopefully could increase the comprehension level and hence the effectiveness of warning signs for the drivers.

REFERENCES

- Al-Madani, H., & Al-Janahi, L. R. (2002). Role of Drivers' Personal Characteristics in Understanding Traffic Sign Symbols. *Accident Analysis and Prevention*, 34, 185–196.
- Banares, J. R., Caballes, S. A., Serdan, M. J., Liggayu, A. T., & Bongo, M. F. (2018). A comprehension-based ergonomic redesign of Philippine road warning signs. *International Journal of Industrial Ergonomics*, 65, 17-25.

- Ben-Bassat, T., Shinar, D., 2015. The effect of context and drivers' age on highway traffic signs comprehension. *Transportation Research, Part F* 33, 117-127.
- Ben-Bassat, T., Shinar, D., 2006. Ergonomic guidelines for traffic sign design ncrease sign comprehension. *Human Factors*, 48 (1), 182-195.
- Brucal, D.M., Canuto, A.L., Garcia, C.A., Tansoc, J.C., 2015. A Study on the design of regulatory road Signs using ergonomic principles of design and comprehension. In: *19th Triennial Congress of the IEA*, (pp. 1-8). Melbourne.
- Bazire, M., Tijus, C., 2009. Understanding road signs. *Safety Science*, 47, 1232-1240.
- Choocharukula, K., Sriroongvikrai, K. (2017). Road safety awareness and comprehension of road signs from international tourist's perspectives: a case study of Thailand. *Transportation Research Procedia*, 25, 4518-4528
- Kirmizioglu, E., Yaman, H.T. (2011). Comprehensibility of traffic signs among urban drivers in Turkey. *Accident Analysis and Prevention*, 45, 131-141.
- Makinde, O.O. & Oluwasegunfunmi, V., (2014). Comprehension of traffic control devices amongst urban drivers-a study of Ado-Ekiti, Ekiti State, Nigeria. *European Journal Engineering Technology*, 9-19.
- Ministry of Transportation. (2014). *Minister of Transportation Regulation No. 13 of 2014*.
- Sodikin, Munawar, A., Setiadji, B. (2013). Drivers' comprehension of the traffic signs. *International Journal of Science Research*, 534-538.
- Shinar, D. & Vogelzang, M. (2013). Comprehension of traffic signs with symbolic versus text displays. *Transportation Research*, 18, 72-82.
- Shinar, D., Dewar, R.E., Summala, H., Zakowska, L. (2003). Traffic sign symbol comprehension: a cross-cultural study. *Ergonomics*, 46 (15), 1549-1565.
- Yuan, L., Ma, Y.-f., Lei, Z.-y., Xu, P.(2014). Driver's comprehension and improvement of warning signs. *Advance Mechanical Engineering*, 6, 1-9

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