Motorcyclists’ awareness and understanding of traffic signs for traffic safety in Yogyakarta

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Abstract. Yogyakarta is not only well-known as a student city in Indonesia, but it is also famous as a national and international tourist destination. These factors result in a significant increase in road use year-after-year. However, the road length could not keep up with this development. It should be noted that more than 75% of road users in this city consist of motorcyclists. To travel safely, one should have good awareness and follows the traffic signs. This study was conducted by distributing 190 questionnaires to common people; online-transportation drivers and students who drive motorcycles, the goal was to examine their understanding of the existing 32 traffic signs and to observe road users’ awareness of their obedience of existing prohibition signs. The study results indicated that the average percentages of drivers who have the correct understanding of 32 traffic signs is 77.11%. Based on gender, the total understanding in male respondents was 76.25% and in female respondents was 79.72%. Despite of good understanding of the prohibition signs, there was 304 violations from the motorbike riders in one-hour observation.

1. Introduction
Road traffic and transportation infrastructure consist of traffic space, terminals, and road equipment that includes road markings, traffic signs, traffic signaling devices, road user control and safety devices, road safety and monitoring tools, and supporting facilities. Traffic signs are parts of road equipment in the form of symbols, letters, numbers, sentences, or a combination of them that serve as a warning, regulation, command, and guide for road users [1, 2].

Warning signs are signs used to express that there may be hazardous or dangerous places on the road and inform drivers about the nature of the danger, such as road infrastructure conditions, natural conditions, weather conditions, environmental conditions, or an accident-prone location. Regulatory or prohibition signs are signs used to specify any actions are prohibited for road users and consist of signs like the ban goes on, entering a ban zone, parking restrictions and stops, guide sign the prohibition of certain traffic movements, prohibition on sounding a voice signal, a ban with words, and the end for bans. Command signs are signs used to express a command which must be obeyed by road users, such as to obey the designated direction, to choose one of the designated directions, to enter certain parts of the road, a minimum speed limit, to use tire chains, to use regular or special traffic lanes, the end for certain commands, and command with words. Guide signs are signs used to provide directions, roads, regional boundary, toll road boundary, situations, public utilities, facility arrangements, and the like to road users [2].

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The city of Yogyakarta is part of the Special Region of Yogyakarta (DIY), which has a distinctive character as a tourist destination city both domestically and internationally, and is also a city of students from all over Indonesia. The number of motor vehicles in Yogyakarta has been increasing from year-to-year, more than 75% consists of motorbikes. Online taxis in Yogyakarta are also growing rapidly, online two-wheeled taxis are 3 to 4 times the number of four-wheeled online taxis. Due to the diverse cultural backgrounds and fast-paced mobility of road users today, their safety and that of other road users will be threatened if they are not supported by orderly behavior and a correct understanding of the meaning of traffic signs.

Based on the results of previous research in DIY, the reasons people do not comply with existing traffic signs or road markings are presented in table 1. The police figure (65%) is the most dominant and feared. The second highest percentage (58%) is road users hurrying. When road users are in a hurry, do they really realize that caring about and understanding the meaning of traffic signs will make their safety and other road users more secure? This comes into question [3].

| No | Reasons                                                      | Percentage |
|----|--------------------------------------------------------------|------------|
| a  | Avoiding trouble                                            | 26%        |
| b  | No police supervise traffic signs                            | 65%        |
| c  | In a hurry                                                   | 58%        |
| d  | Minor sanctions for violations                              | 16%        |
| e  | I saw other people violating the signs, I also violated them | 41%        |
| f  | Road users do not have the culture to drive in an orderly manner | 42%        |

The psychological study of accidents has been particularly useful in explaining why accidents occur despite caution signs and safe conditions. Studies of traffic accidents show that a great many people have dangerous driving attitudes that increase the probability of an accident: overconfidence about their driving ability, a tendency to blame the other fellow, intolerance of authority, aggressiveness, egocentricity and a lack of emotional stability, lack of moral responsibility, a feeling that accidents are inevitable, and the conviction that “it can’t happen to me,” or that “every man has to look out for himself” [4].

Personality traits that invite danger include: 1. Lack of moral responsibility; one possible explanation for why road users under the age of twenty and in their early twenties experience more accidents is due to their lack of moral responsibility. 2. Egocentricity; egocentricity is selfishness. Such people usually lack respect and attention to others. It is easy to understand that people who are selfish and ignore the interests of others will also ignore traffic signs because traffic signs are indeed made for the benefit of many people. 3. Aggressiveness; aggressive road users usually lack patience toward others, easily blame others, are easily offended, angry, and tend to “educate” other people who are judged to have made mistakes. 4. Lack of emotional stability; emotional stability indicates personal maturity, which can be seen through the ability to control oneself and the ability to reduce strong emotional reactions. Emotional instability is often characterized by a strong emotional reaction that comes suddenly and unexpectedly. Related to emotional instability is impulsive behavior, which is marked by “first hit, then thought.” This impulsive behavior is often found in people who experience many accidents. 5. Expressive self-confidence; self-confidence is indeed necessary to be able to drive a vehicle on public roads properly. Confidence in yourself here is positive. However, if this self-confidence swells excessively, then the situation will invite danger [5].

A study about motorists understanding 42 traffic signs in Dhaka city, Bangladesh was conducted through a driver survey. These signs consist of 20 regulatory signs, 17 warning signs, and 5 guide signs. The overall understanding level, measured in terms of percentage of correct answers, was only about 50%. Only 2 regulatory and 2 warning signs were understood by more than 80%. The study results indicated that efforts are needed to educate the drivers on the proper meaning and response to traffic signs [6].
Another study in the Soloraya area in Central Java Province, Indonesia concerned drivers’ comprehension of 15 existing traffic signs, this study indicated that the average correct comprehension of 15 traffic signs is 67% [7].

Another study about drivers understanding traffic signs in Akure City, Ondo State, Nigeria investigated a total of 20 symbolic warning and regulatory signs. The study results showed that drivers have a low understanding of traffic signs. The average percentages of drivers who correctly understood the warning and regulatory signs were 67% and 58%, respectively. Age, education and years of driving experience play an important role in drivers’ understanding of traffic signs [8].

The aims of this study are to investigate motorcyclists’ understanding of traffic signs and to assess their awareness of traffic signs.

2. Subjects and methodology
Research in understanding the meaning of traffic signs was conducted by distributing 200 questionnaires to respondents. The questionnaire consists of two sections, of which the first part was used to obtain characteristic data about the respondents, while the second was designed as multiple choice and was filled out to find out the motorcyclist’s understanding of traffic sign meaning. In this study, respondents were grouped into three types, university students, online drivers and common people who rode motorbikes. A total 32 of signs were evaluated, consisting of 8 warning signs, 8 regulatory signs, 8 command signs, and 8 guide signs, as shown in figure 1. Direct observations were also carried out on the violations committed near one of the prohibition signs to assess the awareness and behavior of respondents.

![Figure 1. The 32 existing traffic signs.](image)

3. Analysis
A total of 200 questionnaires were distributed, but only 190 were filled out completely. Table 2 shows the personal characteristics of the respondents. Online drivers were mostly male (21.6%) and male students were dominant (36.8%) respondents because Yogyakarta city was known as a student city. No wonder the 16–25 year age group students (52.1%) also dominated in this study. Around two-thirds of the respondents came from outside Yogyakarta Special Region. Students, online drivers, and common people were 39%, 12.1%, and 14.2%, respectively. 4.21% of total respondents had no driving license.

Table 3 shows the result of drivers’ understanding based on gender, with total respondents of 143 male and 47 females as seen in table 2. For warning signs, sign number 5 “crossroad ahead” got the highest percentage for male (88.1%) and for female (89.4%). The lowest percentages were for sign number 1 “many children” for male (11.9%) and sign number 2 “level crossing with a barrier-equipped railroad line” was the lowest percentage for female (14.9%). It appears that the highest percentage for prohibition sign understanding for male respondents was sign number 13 “no parking” (99.3%) and for female, signs number 15 “U-turn” and number 16 “no right turn” were both 100%. The lowest
percentage in prohibition sign understanding for male was number 10 “do not enter” (81.1%), and the lowest percentages for female were signs number 9 “stop at intersection” and number 14 “the maximum speed is 40 km per hour and vehicles are not allowed to travel at a speed faster than that”, both at 87.2%. Number 23, command sign “designated directions must be followed” was the highest percentage for male and female, 88.1% and 91.5%, respectively. While number 20, command sign “one of the designated lanes or road sections must be passed” was the lowest percentage for male (45.4%) and female (44.7%). For guide signs, number 26 “parking area” was the highest percentage for male (99.3%), while number 27 “U-turn” was highest for female (100%). However, guide sign number 28 “museum” was the lowest percentage both for male (16.1%) and for female (27.6%).

Table 2. Respondents’ personal characteristics.

| Characteristics          | Respondents | Percentage respondents |
|--------------------------|-------------|------------------------|
|                          | Student     | Online driver | Common people | Student | Online driver | Common people |
| Gender                   | Male        | 70           | 41           | 32      | 36.80%       | 21.60%       | 16.80%       |
|                          | Female      | 30           | 2            | 15      | 15.80%       | 1.10%        | 7.90%        |
| Age                      | 16 – 25     | 99           | 15           | 26      | 52.11%       | 7.89%        | 13.68%       |
|                          | 26 – 35     | 1            | 16           | 19      | 0.53%        | 8.42%        | 10.00%       |
|                          | 36 – 45     | 0            | 12           | 2       | 0.00%        | 6.32%        | 1.05%        |
| Hometown                 | Outside of DIY | 74       | 23           | 27      | 39.00%       | 12.10%       | 14.20%       |
|                          | DIY         | 26           | 20           | 20      | 13.70%       | 10.50%       | 10.50%       |
| Driving license          | Yes         | 100          | 43           | 39      | 52.63%       | 22.63%       | 20.53%       |
|                          | No          | 0            | 0            | 8       | 0.00%        | 0.00%        | 4.21%        |

Table 3. Understanding of traffic signs based on gender respondent.

| Warning signs | Regulatory signs |
|---------------|-------------------|
| Sign No       | Percentage in male respondents | Percentage in female respondents | Sign No | Percentage in male respondents | Percentage in female respondents |
| 1             | 11.9%              | 23.4%                      | 9       | 86.7%              | 87.2%                      |
| 2             | 22.4%              | 14.9%                      | 10      | 81.1%              | 89.4%                      |
| 3             | 78.3%              | 76.6%                      | 11      | 94.4%              | 95.7%                      |
| 4             | 79.0%              | 87.2%                      | 12      | 92.3%              | 97.9%                      |
| 5             | 88.1%              | 89.4%                      | 13      | 99.3%              | 97.9%                      |
| 6             | 73.4%              | 68.1%                      | 14      | 81.8%              | 87.2%                      |
| 7             | 64.3%              | 68.1%                      | 15      | 96.5%              | 100.0%                     |
| 8             | 79.7%              | 87.2%                      | 16      | 95.8%              | 100.0%                     |

| Command signs | Guide signs |
|---------------|-------------|
| Sign No       | Percentage in male respondents | Percentage in female respondents | Sign No | Percentage in male respondents | Percentage in female respondents |
| 17            | 79.7%        | 85.1%                      | 25      | 95.8%              | 93.6%                      |
| 18            | 78.3%        | 87.2%                      | 26      | 99.3%              | 97.8%                      |
| 19            | 72.0%        | 83.0%                      | 27      | 93.0%              | 100%                       |
| 20            | 45.4%        | 44.7%                      | 28      | 16.1%              | 27.6%                      |
| 21            | 50.3%        | 48.9%                      | 29      | 90.2%              | 89.4%                      |
| 22            | 75.5%        | 83.0%                      | 30      | 90.9%              | 89.4%                      |
| 23            | 88.1%        | 91.5%                      | 31      | 97.2%              | 97.9%                      |
| 24            | 53.1%        | 63.8%                      | 32      | 89.5%              | 97.9%                      |

Table 4 shows a comparison between results from research done by previous researchers in Soloraya [7]; it appears that the results of this study have similarities with the research done by [7], which has the
highest percentages in the same guide sign “parking area”, 98.9% and 98%, respectively. Additionally, the lowest percentage was for the same warning sign “many children”, 14.7% for this study and 36% for [7]. The average total percentage of 7 traffic signs in this study was 65 %, while for [7] it was 75.4%. This difference is understandable since the respondents in this study had type C driving licenses, while in the drivers’ comprehension study, they had various types of driving license, ranging from type C to B2 Public. They also had more than 10 years of driving experience. This will help in defining the meaning of traffic signs. Table 5 presents the total correct meaning percentages for drivers understanding each warning sign symbol. The lowest total percentage for warning signs is sign number 1 “many children” (14.7%), the highest total percentage for warning signs is sign number 5 “crossroad ahead” (88.4%), and the average total percentage from 8 warning signs was 62.7%.

Table 4. Part of respondents understanding of traffic signs.

| Symbol | Meaning of signs | Percentage | Results from [7] |
|--------|-----------------|------------|------------------|
| Many children | 14.7% | 36.0% |
| Level crossing with a barrier-equipped railroad line | 20.5% | 87.0% |
| Be careful | 81.6% | 93.0% |
| It is compulsory to follow the direction specified on the roundabout | 74.7% | 89.0% |
| Turn left | 81.1% | 69.0% |
| The maximum speed is 40 km per hour and vehicles are not allowed to travel at a speed of faster than that | 83.2% | 56.0% |
| Parking area | 98.9% | 98.0% |

Table 5. Total percentages for respondents’ understanding of warning signs.

| No | Sign | Meaning of traffic sign | Total Percentage |
|----|------|-------------------------|------------------|
| 1  |      | Many children            | 14.7%            |
| 2  |      | Level crossing with a barrier-equipped railroad line | 20.5% |
| 3  |      | Hill with grade          | 77.9%            |
| 4  |      | Signal ahead             | 81.1%            |
| 5  |      | Crossroad ahead          | 88.4%            |
Table 6 shows that the lowest total percentage for regulatory signs are sign number 10 “do not enter” and sign number 14 “the maximum speed is 40 km per hour and vehicles are not allowed to travel at a speed of faster than that” (83.2%), the highest total percentage for regulatory signs is sign number 13 “no parking” (98.9%), and the average total percentage from 8 regulatory signs was 91.84%.

Table 6. Total percentages for respondents’ understanding of regulatory signs.

| No | Sign | Meaning of traffic sign                                                                 | Total Percentage |
|----|------|----------------------------------------------------------------------------------------|------------------|
| 6  | 🟢🟠 | Side road (Right)                                                                       | 72.1%            |
| 7  | 🟠🟠 | T Intersection ahead                                                                     | 65.3%            |
| 8  | 🟡🟠 | Be careful                                                                               | 81.6%            |
| 9  | 🟥 | Stop at intersection                                                                     | 86.8%            |
| 10 | 🟥 | Do not enter                                                                             | 83.2%            |
| 11 | 🟥⚠️ | No trucks                                                                               | 94.7%            |
| 12 | 🟥 | No stop                                                                                 | 93.7%            |
| 13 | 🟥 | No parking                                                                              | 98.9%            |
| 14 | 🟥40° | The maximum speed is 40 km per hour and vehicles are not allowed to travel at a speed of faster than that | 83.2%            |
| 15 | 🟥 | No U-Turn                                                                               | 97.4%            |
| 16 | 🟥 | No Right Turn                                                                           | 96.8%            |

Table 7. Total percentages for respondents’ understanding of command signs.

| No | Signs | Meaning of traffic sign                                                                 | Total Percentage |
|----|-------|----------------------------------------------------------------------------------------|------------------|
| 17 | 🟣meyele | Turn left                                                                              | 81.1%            |
| 18 | 🟣meyele | Must go straight ahead                                                                  | 80.5%            |
| 19 | 🟣meyele | It is compulsory to follow the direction specified on the roundabout                   | 74.7%            |
| 20 | 🟣meyele | One of the designated lanes or road section must be passed                              | 45.3%            |
Table 7 shows the total percentage of correct meaning for drivers’ understanding of each command sign symbol. The lowest total percentage for command signs is sign number 20 “one of the designated lanes or road sections must be passed” (45.3%), the highest total percentage for command signs is sign number 23 “designated direction must be followed” (88.9%), and the average total percentage from 8 command signs was 69.21%.

Table 8 shows the correct meaning results for drivers’ understanding of each guide sign symbol. The lowest total percentage for guide signs is sign number 28 “museum” (18.9%), the highest total percentage for guide signs is sign number 26 “parking area” (98.9%), and the average total percentage from 8 guide signs was 84.66%.

Table 8. Total percentage of respondents’ understanding of guide signs.

| No | Signs | Meaning of traffic sign       | Total Percentage |
|----|-------|--------------------------------|------------------|
| 25 |       | Place for worship              | 95.3%            |
| 26 |       | Parking area                   | 98.9%            |
| 27 |       | U-turn                         | 94.7%            |
| 28 |       | Museum                         | 18.9%            |
| 29 |       | Zebra crossing place           | 90.0%            |
| 30 |       | Hospital                       | 90.5%            |
| 31 |       | Fueling station                | 97.4%            |
| 32 |       | Airport                        | 91.6%            |

Finally, the respondents’ understanding of 32 traffic signs showed an average total percentage of 77.1%.
One-hour observations were carried out in six places with “do not enter” prohibition signs installed; the results are shown in table 9. Violators understand the meaning of prohibition signs, but they pretend not to understand, or the signs are not visible, because they must take a detour if they do not violate the traffic signs. The others tend to follow along. Violation of prohibition signs at Ketandan Kulon street is the highest among the places observed; 304 motorcyclists violated in the one-hour observation.

Table 9. Violation of prohibited signs within 1 hour of observation.

| Location          | Type of vehicle | Car | Motor-bike | Becak |
|-------------------|-----------------|-----|------------|-------|
| Sosrowijayan      | 0               | 126 | 0          |       |
| Pajeksan          | 1               | 125 | 0          |       |
| Beskalan          | 1               | 90  | 0          |       |
| Ketandan kulon    | 3               | 304 | 19         |       |
| Ketandan lor      | 0               | 51  | 5          |       |
| Lempuyangan       | 3               | 10  | 11         |       |

4. Conclusion and recommendation

The average total percentage of the respondents’ understanding of 32 traffic signs shows quite a significant number, 77.1%. While the average total percentages for 8 warning signs, 8 regulatory signs, 8 command signs, and 8 guide signs, were 62.7%, 91.84%, 69.21%, and 84.66%, respectively. Those results show that most respondents have a good understanding of the traffic signs. Unfortunately, that does not mean that they follow the rules despite having this understanding.

Motorcyclists tend to be indifferent to the benefits and existence of traffic signs; violations of signs are considered not scary even though it is punishable. Many of them have similar thoughts about a shortcut, that is faster and easier compared to the correct way, which sometimes required more complicated routes and takes longer times. An example of this thought can be seen in the violation of prohibition signs at Ketandan Kulon street. It is the highest among the observed places, with 304 motorcyclists violating prohibition signs during the one-hour observation.

To improve the situation and increase awareness of traffic signs, the following recommendations are proposed: 1. Holding mandatory workshops and seminars regarding this theme in schools and universities; 2. Using university, public, or community service programs to convey the messages; 3. Collaborating with the government and police departments to strengthen the law regarding the punishment for breaking road rules, regularly checking the traffic signs, and related programs.

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