Traffic signs comprehension study

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Abstract. Current research work investigates road user’s comprehension of different traffic control devices. Sample demographics were taken into consideration such as age, gender, and educational background. Twenty regulatory and warning signs were examined in this study. These signs vary from simple ‘No parking’ sign to more tricky ones such as ‘Divided highway’ sign. In addition, the questionnaire includes other questions related to road safety, condition of roads signs, and feeling of safety as a driver and as a pedestrian. These signs were selected based on their popularity among other road signs. The selected sample was over 100 people from different regions in Iraq (mainly southern provinces and the capital Baghdad). Only 16% of selected sample answered with yes when asked about feeling safe as a driver, whereas 29% feels safe as a pedestrian. None of the respondents got all the 20 signs meaning correct, and the highest percent of correct sign meaning was associated with pedestrian crossing sign (98.2%). On the other hand, flagger man sign (work zone sign) had the lowest correct score of (19.8%). Overall Average of correct signs meaning was (68.5%). Approximately, 25% of traffic signs have scored less than 50%, and 75% of traffic signs scored more than 50% correctness score. A great work needs to be done to educate and spread adequate material that explains uses and meanings of different road signs.

Key words
Traffic control devices, demographic information, traffic signs comprehension, educational background.

1. Introduction
Traffic control devices are essential for traffic safety on roadways. Their role is crucial in delivering highway information to drivers and other road users. When installing a new traffic control device or certain road sign, the underlying assumption is that most road users know the meaning of the sign.

This is not always correct, sometimes signs are not understood by all drivers. Some signs could be interpreted in different ways, or due to similarity of some road signs could be misleading and confusing. This topic has gained a good interest among researchers to investigate the case of road signs misunderstanding among drivers.

Several factors can contribute for drivers in correct comprehension of traffic control devices such as: a) the growing complexity of driving in urban areas, b) the continuous updating of traffic control devices, and c) the lack of adequate knowledge given in the driver’s education before getting the driving license. Certainly, the absence of proper road signs that warn drivers of road conditions and changes in geometry or changes in speed limit for different road sections can contribute to high accident rate, especially in country like Iraq.
Current research work will investigate different traffic signs by the driver population based on a survey form distributed to a sample of 111 persons, which represents various cities in Iraq. The survey form consisted of 20 common traffic signs of different types (regulatory, warning, and guide signs).

2. Background
This topic has gained a significant interest among transportation researchers to help understand road user’s comprehension of various traffic control devices. For instance, a study conducted in the USA and Canada to test whether age has an effect on traffic signs comprehension [1]. The test sample consisted of 85 US traffic signs. The results showed that younger people have better comprehension than older people for 39% of the sample. However, for the rest sample there were no changes with respect to age. The researchers recommended that there should be a broad and systematic assessment of road users’ understanding of various traffic signs. Another research has tested posted speed signs recall after certain delay time (1 minute) and found that approximately 94% of tested sample has remembered the posted speed limit [2].

Studying the effect of traffic signs understanding on roadway accidents, tickets, and seat belt use [3,4]. The results of these studies showed that there is a connection between traffic signs comprehension and set belt use, but no relationship with accident cases was found. Additionally, the citation or tickets received found to have no association with drivers’ demographics. Worth noting here is that drivers with lower number of speed tickets have no advantage in guessing the correct sign meaning over drivers with lower speed tickets.

An experiment designed to test the cognitive design features of 120 traffic signs in mainland China [5]. The features included are simplicity, name similarity, concreteness, meaningfulness. A rating scale between 0 and 100 for each sign for the four categories mentioned earlier. Research results showed a significant association among signs concreteness, familiarity, semantic closeness, and meaningfulness. Researchers suggested that this kind of testing traffic signs comprehension helps to design new traffic or traffic signs that are proposed for future implementation. Moreover, this design can help to build and design more friendly traffic control devices. These devices are supposed to convey clear, and simple message along the roads related to any warning or possible traffic incidents.

A driver survey was used to assess traffic signs understanding of various guide, warning, and regulatory signs. The sample included comprised of 202 Dhaka city drivers, a total of 42 traffic signs were evaluated [6]. These signs consist of five guide signs, 17 warning signs, and 20 regulatory signs. The results showed poor understanding of traffic signs by road users, with average correctness score of 50%. Furthermore, only 4 traffic signs had scored over 80% out of the used 42 traffic signs. Some of the study suggest conducting a comprehensive and systematic program to educate and spread the knowledge of correct traffic sign meanings.

Both important user factors and traffic signs features on driver’s comprehension were considered [7]. Only level of education was found to be a good indicator of guessing the correct meanings of traffic signs. However, there was no similar observation from other characteristics such as age, cultural background or gender. Generally, drivers perform better, especially familiar signs; which they are exposed to frequently. One conclusion from this study was that traffic signs misconception related to the design of traffic signs itself.

A study conducted in Thailand to examine foreigner’s comprehension of traffic signs and compliance to local traffic laws [8]. The study involves a questionnaire and around 1,091 foreign tourists who were visiting Thailand at the time of study. Drivers’ comprehension of traffic sign found to be different based on their origins. A total of 25 regulatory and warning signs were used in the
survey and the respondents needed to answer with ‘yes’ or ‘no’ regarding the sign meanings, also to require writing down using their own words the correct meaning of each sign. Respondents with Asian origins showed a better level of traffic signs comprehension as compared to other regions. This is due to the fact that tourists from Asian countries, especially Thailand are somehow familiar with traffic environment and traffic signs. Adding text in local language to traffic signs could increase their comprehension, but only for local road users and is not applicable for foreigners. Current study showed that adding text makes it harder for visitors unfamiliar with the local language.

Another study was conducted in Nigeria to assess the effect of traffic signs understanding of local sample taking into account socio-economic factors such as age, educational background, gender, and marital status [9]. The study was conducted using 32 signs categorized as eight warning signs, six informative signs, ten regulatory signs, five road markings, and last three traffic signal lights. The outcomes of this study showed that drivers had a low comprehension level of traffic signs. The percentage of drivers who got the correct meanings was 64.5%. It is found that education has an effect on drivers’ understanding of traffic signs. However, age and gender have no effect. Furthermore, from statistical test it was found that level of education and traffic signs comprehension are dependent on each other.

3. Methodology

3.1 Questionnaire design
Field Surveys and online form surveys using google forms were used in current research work. Both surveys share the same questions and traffic signs. The survey consists of two main parts: the first part contains questions regarding socio-economic and demographic data and some questions targeting sample responses about roads safety and the condition of road signs (i.e., Age, Sex, driving experience, and driving license). The second part consists of a test of knowing the correct meaning of 20 common warning, regulatory, and guide signs. The survey printed on a single paper where the front page contains the demographic information and the back contains 20 colorful traffic signs with different shapes diamond, circular, rectangle and triangle. The respondents were asked to write down the correct meaning of each sign based on their familiarity with these signs or simply guessing the meaning from sign colors, shape, and written words. Figure 1 depicts all signs used in the survey which are numbered from 1 to 20. In addition, correct meanings of traffic signs are presented in Table 1.

3.2 Demographic Survey Part
As mentioned earlier first part of the survey questionnaire contains information about sample demographics and few questions related to feeling of safety as drivers and as pedestrians. Males represent 58% of sample size, whereas females represent 42%. There were five age groups in this study as shown in figure 2 with their associated percentages. Moreover, the majority of surveyed sample (89%) has at least 4-year college degree and higher. The rest represent high school or less. Driving and driving license are both included in the questions; which may have an effect on sign comprehension among the sampled drivers. The sample comprises of 86% of drivers and 14% of not drivers, and 62% have a valid driving license and 38% without valid driving license. The latter percent is considerably high, and it is illegal in most countries to sit behind the steering wheel without a valid driving license. Additional items are driving experience years which was categorized into four categories as shown in figure 3.
**Figure 1.** Traffic signs used in survey

**Table 1.** Correct meaning of used traffic signs

| Sign number | Meaning                  | Sign number | Meaning                   | Sign number | Meaning            | Sign number | Meaning             |
|-------------|--------------------------|-------------|---------------------------|-------------|--------------------|-------------|---------------------|
| 1           | Side road                | 6           | Student crossing area     | 11          | Detour ahead       | 16          | One-way road        |
| 2           | No parking bus stop      | 7           | No stopping               | 12          | No trucks allowed  | 17          | Beginning of undivided highway |
| 3           | Beginning of divided highway | 8         | No entry                  | 13          | Max. speed limit   | 18          | Curvy road ahead    |
| 4           | U-turn                   | 9           | Falling rock              | 14          | Maximum height     | 19          | Steep slope warning |
| 5           | Pedestrian crossing      | 10          | Two-way road              | 15          | Flagger man        | 20          | roundabout          |
The majority of questionnaire sample was from Baghdad and small percentage was from other Iraqi cities; and for this reason, the results of current research basically reflects City of Baghdad driver’s ability to guess the correct traffic signs meanings.

4. Results
4.1 Road Safety Prospective
Three important questions were conducted in this study. These are related to roads safety, traffic signs physical condition (good or not good), and the ability to understand traffic signs easily. Sample responses were recorded using five-point linear scale, where one represents the lowest score (strongly
disagree) and five represents the highest score (strongly agree) as shown in figure 4. Only 2% strongly
agreed that roads are safe in general, and highest score of 39% was associated with neutral situation
neither agree nor disagree.

Regarding understanding signs meaning 49% are somewhat agree which is the highest percent
among other choices. Finally, road signs condition 49% are somewhat agree that traffic signs are in
good condition while only 4% strongly disagree. These results are a good reflection of the actual
driving experience in City like Baghdad. Busy and crowded streets without proper road signage. In
addition, the traffic law enforcement is not well equipped, and their main job is to manage vehicular
traffic at major intersections and roundabouts.

![Sample response summary regarding safe roads, traffic signs condition, and traffic signs comprehension](image)

**Figure 4.** Sample response summary regarding safe roads, traffic signs condition,
and traffic signs comprehension

Additional two questions about feeling safe as a driver and as a pedestrian, the sample response
recorded using three ranking criteria (yes, somewhat yes, and no). Table 2 summarizes the
questionnaire results regarding these two questions. It is clear that both road users (i.e., drivers and
pedestrians) are not so confident about feeling safe, which reflects a realistic situation in Baghdad city
where traffic laws and regulations are not enforced and many times you will find yourself committing
a traffic violation unconsciously. In order to feel safe, a great effort is needed to make sure there is
clear and comprehensible traffic laws and knowing that law enforcement is there when needed.

|                  | Yes | Somewhat yes | No |
|------------------|-----|--------------|----|
| Do you feel safe as a driver | 16% | 51% | 33% |
| Do you feel safe as a pedestrian | 29% | 53% | 18% |

**Table 2.** Safety feeling for both drivers and pedestrians among questionnaire sample

4.2 Traffic signs comprehension results
The highest score of correct traffic sign meaning was 98.2% for sign no. six (‘pedestrian crossing ahead’). On
the other hand, the ‘flagger man’ sign (sign no. 15) has scored the lowest among the 20 signs (19.8%). Summary
of correct scores of the questioned 20 traffic signs are demonstrated in Figure 5. Overall average correct score is
68.5%, which is surprisingly good taking into consideration the lack of exposure of road users for most of these
signs that are rarely seen on most roads and highway sections. In order to test the effect of demography on guessing the correct sign meaning, Chi-Square test was used as will be discussed in the following sections.

4.3 Traffic signs comprehension statistical test

A chi-square test was used to test whether demographics of sample such as age, gender, and driving experience has an effect on guessing the correct meaning of traffic signs. This test is commonly used to examine rejection of the null hypothesis stating the independence of data. Age, gender, education background, and driving experience parameters were used for all 20 traffic signs used in the current study. Tables 3, 4, 5, and 6 summarize the chi square test results considering age, gender, educational background, and driving experience. The calculated chi-square values of each sign were compared to critical value from a chi-square table to decide the significance difference.

**Figure 5. Summary of correct scores of used traffic signs in the questionnaire survey**

| Table 3. Chi square test results (Age group) | Table 4. Chi square test results (Gender) |
|-------------------------------------------|------------------------------------------|
| Sign No. | Chi-square (calculated) | Chi-square (tabulated) | P value | Significance | Sign No. | chi-square (calculated) | chi-square (tabulated) | P value | significances |
| 1        | 1.6462                  | 9.488                     | 0.800474 | Not significant | 1        | 0.0006                  | 3.841                    | 0.97969 | Not significant |
| 2        | 4.7091                  | 9.488                     | 0.318467 | Not significant | 2        | 0.5387                  | 3.841                    | 0.462971 | Not significant |
| 3        | 21.614                  | 9.488                     | 0.002039 | significant     | 3        | 0.8994                  | 3.841                    | 0.342937 | Not significant |
| 4        | 3.4042                  | 9.488                     | 0.492596 | Not significant | 4        | 0.5387                  | 3.841                    | 0.462971 | Not significant |
| 7        | 1.8851                  | 9.488                     | 0.756877 | Not significant | 5        | 0.0118                  | 3.841                    | 0.913619 | Not significant |
| 8        | 4.9436                  | 9.488                     | 0.293132 | Not significant | 6        | 0.0489                  | 3.841                    | 0.824953 | Not significant |
| 9        | 5.0368                  | 9.488                     | 0.283543 | Not significant | 7        | 1.4375                  | 3.841                    | 0.230548 | Not significant |
| 10       | 1.5275                  | 9.488                     | 0.821764 | Not significant | 8        | 1.8868                  | 3.841                    | 0.169563 | Not significant |
| 11       | 4.1693                  | 9.488                     | 0.383584 | Not significant | 9        | 0.2381                  | 3.841                    | 0.625603 | Not significant |
| 12       | 1.0817                  | 9.488                     | 0.897163 | Not significant | 10       | 0.1796                  | 3.841                    | 0.671756 | Not significant |
| 15       | 7.8037                  | 9.488                     | 0.099004 | Not significant | 11       | 0.0365                  | 3.841                    | 0.848501 | Not significant |
| 16       | 2.3632                  | 9.488                     | 0.669299 | Not significant | 12       | 0.0876                  | 3.841                    | 0.767225 | Not significant |
| 17       | 5.1307                  | 9.488                     | 0.274147 | Not significant | 13       | 0.2071                  | 3.841                    | 0.649067 | Not significant |
| 18       | 3.3875                  | 9.488                     | 0.495187 | Not significant | 14       | 0.1328                  | 3.841                    | 0.7155 | Not significant |
| 19       | 5.4697                  | 9.488                     | 0.242407 | Not significant | 15       | 0.1089                  | 3.841                    | 0.741448 | Not significant |
| 20       | 0.1524                  | 3.841                     | 0.696299 | Not significant | 16       | 0.4992                  | 3.841                    | 0.479851 | Not significant |
|          |                        |                           |          |               | 17       | 2.0342                  | 3.841                    | 0.153792 | Not significant |
|          |                        |                           |          |               | 18       | 0.4613                  | 3.841                    | 0.497031 | Not significant |
|          |                        |                           |          |               | 19       | 0.0706                  | 3.841                    | 0.790495 | Not significant |
|          |                        |                           |          |               | 20       | 0.1524                  | 3.841                    | 0.696299 | Not significant |
As can be seen from Table 3 that only sign 3 shows a significant value; which means that the age group has an effect on the results of guessing the correct meaning of this particular sign (‘divided highway begins’). Moreover, table 4 shows that gender does not have an effect on the correctness score of the tested traffic signs. Furthermore, table 5 shows that only signs 8 and 16 have a significant result, which means that educational level affects respondents score. Finally, table 6 depicts that signs 8, 9, and 16 have significant values and higher level of driving experience helps respondents guessing the correct meanings of these signs. It is worth to mention that not all signs have been reported here; since some of these traffic signs have either very high correct scores or very low correct scores and the difference between observed and estimated is almost null such as signs (pedestrian crossing, school crossing area, maximum height warning, maximum speed limit, and no trucked allowed warning).

**Table 5. Chi square test results (Educational Background)**

| Sign No. | Chi-square calculated | Chi-square critical (tabulated) | P value | Significance | Conclusion         |
|---------|-----------------------|---------------------------------|---------|--------------|--------------------|
| 1       | 1.5004                | 5.991                           | 0.472   | not significant | Accept the null hypothesis |
| 2       | 4.8699                | 5.991                           | 0.219   | not significant | Accept the null hypothesis |
| 3       | 2.2281                | 5.991                           | 0.032   | not significant | Accept the null hypothesis |
| 4       | 4.3033                | 5.991                           | 0.111   | not significant | Accept the null hypothesis |
| 5       | 1.5785                | 5.991                           | 0.454   | not significant | Accept the null hypothesis |
| 6       | 8.6086                | 5.991                           | 0.013   | significant | Reject the null hypothesis |
| 7       | 0.3714                | 5.991                           | 0.679   | not significant | Accept the null hypothesis |
| 8       | 0.1359                | 5.991                           | 0.934   | not significant | Accept the null hypothesis |
| 9       | 4.3572                | 5.991                           | 0.113   | not significant | Accept the null hypothesis |
| 10      | 5.8328                | 5.991                           | 0.054   | not significant | Accept the null hypothesis |
| 11      | 1.5483                | 5.991                           | 0.461   | not significant | Accept the null hypothesis |
| 12      | 9.208                 | 5.991                           | 0.010   | significant | Reject the null hypothesis |

**Table 6. Chi square test results (Driving experience)**

| Sign No. | Chi-square calculated | Chi-square critical (tabulated) | P value | Significance | Conclusion         |
|---------|-----------------------|---------------------------------|---------|--------------|--------------------|
| 1       | 1.990                 | 4.988                           | 0.737   | not significant | Accept the null hypothesis |
| 2       | 0.577                 | 4.988                           | 0.965   | not significant | Accept the null hypothesis |
| 3       | 6.478                 | 4.988                           | 0.166   | not significant | Accept the null hypothesis |
| 4       | 1.940                 | 4.988                           | 0.746   | not significant | Accept the null hypothesis |
| 5       | 14.79                 | 4.988                           | 0.005   | significant | Reject the null hypothesis |
| 6       | 10.84                 | 4.988                           | 0.028   | significant | Reject the null hypothesis |
| 7       | 4.468                 | 4.988                           | 0.346   | not significant | Accept the null hypothesis |
| 8       | 2.683                 | 4.988                           | 0.612   | not significant | Accept the null hypothesis |
| 9       | 4.164                 | 4.988                           | 0.384   | not significant | Accept the null hypothesis |
| 10      | 6.83                  | 4.988                           | 0.145   | not significant | Accept the null hypothesis |
| 11      | 8.807                 | 4.988                           | 0.0661  | not significant | Accept the null hypothesis |
| 12      | 5.191                 | 4.988                           | 0.281   | not significant | Accept the null hypothesis |
| 13      | 9.541                 | 4.988                           | 0.04890 | not significant | Accept the null hypothesis |
| 14      | 0.046                 | 4.988                           | 0.999   | not significant | Accept the null hypothesis |
5. Discussion
Traffic signs understanding is essential and according to the current research results, there was a bit of misunderstanding among most surveyed sample of the correct meaning of different traffic signs. For instance, ‘flagger man’ sign scored the lowest in terms of correct answer. This was expected since work zone activities in the city is not familiar with such sign. Consequently, local drivers are not exposed sufficiently to these kinds of signs. Furthermore, overall driver’s comprehension of traffic signs was surprisingly good; which reflects a good sense of traffic signs and markings. This could be due to the fact that the majority of surveyed sample have at least 4-years college degree.

6. Conclusions
Based on the outcome of current research the following conclusions can be drawn:

1. Different levels of traffic signs comprehension were observed among the questionnaire sample.
2. The overall average score of correct sign meanings is approximately 68%, which is considered high in view of absence of most traffic signs from Iraq streets and highways used in the questionnaire.
3. The highest correct meaning score was associated sign no. 5 (pedestrian crossing sign) (95.5%); which is an obvious sign and regardless of drivers age, education level, driving experience, and gender.
4. The lowest score was associated with sign no. 15 (flagger man sign) (19.8%), and this was expected due to the unfamiliarity of Iraqi drivers with such sign.
5. Highest scores were associated with traffic signs (7, 10, 12, 13, 14, and 20); which represents (no stopping, no trucks allowed, maximum speed limit, maximum height, and roundabout) signs, respectively. This result showed a good familiarity of drivers with such signs that has written words on it.
6. There is a need to standardize traffic signs colors, and dimensions, and make sure that local drivers are familiar with these signs.

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