

Impacts of Driver's Socio-Demographic Attributes on Road Sign Cognition: Evidence from Iraq

Firas H. A. Asad

Department of Civil Engineering, Faculty of Engineering, University of Kufa, Iraq
(firas.alwan@uokufa.edu.iq)

Abstract- The contribution of traffic signs in minimizing road collisions and maximizing traffic flow smoothness has been long recognized and agreed. The effectiveness of this contribution however largely depends on the driver's cognition for these signs. This study aims to investigate the relative influence of driver's socio-demographic factors on road sign cognition. Adopting non-experimental correlational research design, a cross-sectional travel survey with decent sample size (410 respondent) has been carried out in Al-Najaf Governorate (Iraq) in early 2017. A paper-based questionnaire has been designed and randomly selected drivers were asked about the correct meaning of 20 local road signs. The analysis shows that the overall comprehension level is just over 70%. Whereas driver's profession, education and residence location are found influential, driver's age, gender and marital status have no significant influence on sign understanding. In addition, several signs have been found with low understanding levels. As a result, official highway and traffic decision makers should take prompt actions. Initiating extensive and effective awareness campaigns and traffic education programs are of great importance. Priority should be given to drivers who are low educated, self-employed and live out of cities. The signs that have low understanding levels should be given top priority. The relatively large sample survey, the statistical-based evidence, and the lack of similar studies in Iraq make the findings of this study important and informative.

Keywords- *Traffic Sign Comprehension, Posted Road Sign, Socio-Demographic Attributes*

I. INTRODUCTION

Road signs, along with traffic signals and road markings, are crucial in managing and controlling road transport. Traffic signs are means for conveying messages to road users, especially drivers, in order to inform them about traffic regulatory laws and ordinances, to warn them about potential dangers ahead, and also to provide them with useful trip-related information (MUTCD, 2009). Hence, traffic signs play a vital and principal role in promoting highway safety and traffic flow efficiency. However, the effectiveness of this role can be highly compromised when the messages conveyed by these

signs are not understood at best or misunderstood at worst. The purpose of the present study, therefore, is to explore and quantify the relative influence of drivers' socio-demographic factors on their understanding to road signs. Findings are expected to be informative for local highway and traffic directorate in specific and all researchers and practitioners interested in evaluating and improving the role of traffic signs.

II. LITERATURE REVIEW

The reviewing of relevant available literature revealed that studies examined the potential contributing factors to drivers' perception and reaction to posted road signs can be broadly divided into two principal categories. The first is based on the classification of these contributing factors - driver's personal characteristics; driving behaviour and sign design features. The second category is based on the perception/reaction response type recorded - typical responses include sign comprehension, sign remembering, sign recognizing and sign respecting. Table 1 lists some of these studies with focus on findings regarding the potential impacts of drivers' characteristics on their comprehension to road signs.

The review process has highlighted an important issue regarding the consistency of results concerning driver's factor. That is, whereas the effects of some factors are relatively agreed, the effects of others are not. For example, there is a clear agreement on the direct proportion between academic qualification (education) and sign comprehension (Al-Madani, 2002a, b; Ng and Chan, 2008; Ismail, 2012; Makinde and Oluwasegunfunmi, 2014). Similarly, it is agreed that nationality and hence traffic culture has significant impact on sign understanding (Al-Madani, 2002a, b; Choocharukul and Sriroongvikrai, 2017). In contrast, the influences of age, sex, marital status, driving experience, and crash rate lack compatibility. For example, the conclusion of Makinde and Oluwasegunfunmi (2014) that age and sex have no clear impact on sign comprehension was contradicted by Sodikin et al. (2016) and Ma et al. (2014). The main information about the reviewed studies along with their key findings are shown Table 1.

TABLE I. SUMMARY OF REVIEWED STUDIES

Study	Method	Comprehension Level	Key findings
Al-Madani and Al-Janahi (2002 a, b)	SAQ ⁽¹⁾ / 4850 respondents / 28 posted signs.	Driver comprehension / 55% and 56%	Western drivers have higher CL ⁽²⁾ than those reside in Arabian Gulf region. Drivers who are female, 16-24 years old, low income and with low educational have less CL than others. Crash frequency, driving experience, and marital status are not influential.
Ng and Chan (2008)	SAQ or by interviewer / 109 respondents / 21 signs.	Driver comprehension / 69.9%	Drivers with higher education level have higher CL. As years with driving license increase, CL decreases. Driving experience, age and driving frequency are not influential. Sign familiarity increase CL.
Ismail (2012)	SAQ./1750 persons /24 posted signs.	Driver comprehension and familiarity / 53%	Drivers who are old, female, with low education, not from urban areas, and with low driving experience, and high crash frequency have low CL. Marital status is not influential. Drivers who drive private car have higher CL than other types of vehicles.
Lai (2012)	Simulating reality in Lab. using computer /32 participant / 6 kinds of GRIP.	Driver comprehension	Graphical route information panels (GRIP) with complex design affects CL negatively.
Shinar and Vogelzang (2013)	Trials in Lab. / 48 respondent /30 resembled signs.	Driver comprehension level and comp. time	Sign design features affect affects CL and reaction time. Drivers have high CL and less reaction time for text signs than symbolic ones.
Makinde and Oluwasegunfunmi (2014)	SAQ/ 142 respondents / 32 signs.	Driver comprehension / 60%	Drivers with high education level have high CL. Driver's age and gender are not influential.
Ma, Shao, song and Chen(2014)	SAQ and interviews / 8477 respondent / 32 signs.	Driver response tendency to VMS	CL for VMS is affected by driver's age, gender, driving experience, vehicle type and driver's personality. Drivers who are female, calm, with higher driving experience, and with private vehicles are more likely to respond to VMS than others.
Sodikin, Munawar and Setiadji (2016)	SAQ/ 202 respondents / 15 signs.	Driver comprehension / 67%	Driver's sex, age, education level, occupation, driving license type and duration are influential on CL.
Choocharukul and Sriroongvikrai (2017)	SAQ / 1033 foreign drivers / 25 signs.	Driver comprehension / 68.6%	Foreign drivers who are younger, with driving license in their home country, who had experience in driving in foreign countries, longer residence would be more likely to understand road signs. Asian drivers have lower CL than others.

(1) Self-adminstrated questionnaire (2) Comprehensibility level.

III. SURVEY DESIGN

A. Sample frame and sample size

The sampling frame for the survey is the total number of active drivers in Al-Najaf governorate. The number of total drivers is practically difficult to be accurately determined since a considerable portion of those drivers are without driving license. However, according to the most recent statistics of the Iraqi Central Statistical Organization (CSO), the total number of private motorcars in Al-Najaf governorate up to the end of 2015 is almost 168,750 vehicles (CSO, 2016). This, therefore, has been taken as a proxy to the total number of drivers. Being the survey population is fairly greater than 100,000, it can be considered as large and hence a sample size larger than 358 respondents is the target for margin error ± 5 and 95% confidence level (Rea, 2014, p.169). Such sample size criterion can aid in obtaining a survey sample that is representative to their population as long as random selection is considered.

B. Sample approaching and survey administration

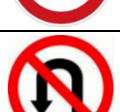
In-person interview technique has been chosen as the most viable option to reach the potential respondents. A structured paper-based questionnaire has been designed as the survey instrument. A group of third stage and senior civil engineering

students have been trained well to interview the potential respondents properly.

C. Survey questionnaire design

The questionnaire consists of 2 main parts. Part 1 includes questions about driver personal characteristics such as age, gender, marital status, job status (profession), place of residence and education level. Also it includes some driving related questions. Part 2 includes photos of 20 road signs that are in use in Al-Najaf city road network. Since Iraq follows Vienna sign convention (Vienna convention, 1968), the signs can be classified accordingly to: six danger warning (W), eleven regulatory (R) and three informative (I) (Table 2). Based on their current knowledge, respondents are asked to choose the right meaning of each sign from four choices available; "I don't Know" is always available as a 5th choice. To numerically quantify respondent's understanding, zero score is assigned for wrong answer, 1 for "I don't know" and 2 for correct answer. Similar scoring system was adopted in several studies such as Ng & Chan (2008). The comprehension level for each respondent is then computed as the sum of his/her obtained scores divided by the sum of scores when all questions are answered correctly (i.e. 40). The total comprehension level for the sample is the average of all respondents' comprehension levels.

TABLE II. ROAD SIGNS INCLUDED IN THE CURRENT STUDY

No.	Sign	Meaning	No.	Sign	Meaning
1		W- Double bend ahead	11		R - No parking
2		W- T-junction on the right ahead	12		R - No right turn
3		W- Pedestrian crossing ahead	13		R- Max. load is 20 ton
4		W- Speed hump ahead	14		R- No parking; No standing
5		W- right bend ahead	15		R- No entry
6		W- General warning	16		R- Only thru and RT movements allowed
7		R- Max vehicle height is 3.8m	17		R- Use the roundabout
8		R- Max speed is 60	18		I – Hospital is around
9		R- No trucks	19		I – Parking is allowed
10		R- No U-turn	20		I – Petrol station is around

D. Conducting Survey

The questionnaires were then distributed during December 2016 to March 2017. About 430 completed forms have been obtained. However, after removing suspected forms, the final number of questionnaires is 410. Questions have been coded and computerized to create a database eligible for quantitative statistical analysis.

E. Statistical analysis

Descriptive statistics has been used to investigate respondents' characteristics and their sign understandings levels. Inferential statistics, in contrast, has been employed to investigate the existence and significance of potential relationships between driver's attributes and sign comprehension. Independent samples T-test and analysis of

variance (ANOVA) were used for testing the significance of difference in means among the groups of dichotomous and nominal categorical factors respectively (Gerber and Finn, 2013). For both T- and ANOVA tests, the null hypothesis is that the variance in the explanatory variables (socio-demographics) is not significantly associated with the variance in the level of comprehension at 0.05 level of significance (p-value).

IV. RESULTS AND DISCUSSION

A. Socio-demographic characteristics of respondents

Table 3 shows the personal characteristics of the respondents (drivers) in the survey sample. In specific, the table shows the numbers and proportions of drivers in each attribute category. For respondent's age, about 70% of the drivers are in the 18-40 age group. The majority of respondents are male (86%); however, it is useful to report that the percentage of women driving has been noticeably increased over the past 10 years. The percentage of married drivers are 68%; the "Other" category may include divorced and widowed. With respect to education, 37% of drivers are below university education level and just over half of them are graduates. About 40% of the respondents are employed, 20% are students and 33% have their own trade or business. Finally, regarding place of residence, about 90% of drivers live in Al-Najaf and Kufa cities (the main two cities within Al-Najaf governorate). The other 10% lives in suburban and rural areas outside these two cities but within the governorate.

TABLE III. DRIVERS' SOCIO-DEMOGRAPHIC CHARACTERISTICS WITHIN SURVEY SAMPLE

Characteristics		Sample number	Percentage %
Age(in years)	18 – 30	173	42.6
	31 – 40	105	25.9
	41 – 50	94	23.1
	Elder than 50	34	8.4
Gender	Male	348	86.4
	Female	55	13.6
	Others	15	3.7
Marital status	Single	115	28.1
	Married	279	68.2
	Others	15	3.7
	Others	15	3.7
Education level	Primary school	34	8.3
	Interm. School	67	16.4
	Hi School	50	12.3
	BSc	211	51.7
Job status	Higher studies	46	11.3
	Student	82	20.1
	Employed	170	41.7
	Self-employed	136	33.3
Residence	Others	20	4.9
	Najaf City	278	68.1
	Kufa City	88	21.6
	Others	42	10.3

B. Comprehension level

1) Total comprehension level

Computing the total comprehension score for each driver based on the correctness of their answers about the meaning of the twenty signs yielded that the average total sign comprehension level for the drivers is 70.4%. Whereas this level can be considered relatively acceptable regarding corresponding levels reported in the reviewed studies (Table 1), it is still considered as a serious challenge for assuring safe and efficient road traffic system.

2) Comprehension by sign type

Table 4 cross-tabulates drivers' comprehension by the number of their "Wrong", "I don't know" and "Correct" answers and by sign type. Amongst the six danger warning signs, sign no. 5 (sharp bend ahead) has the lowest correct answers (38% = 152/404). For reducing accidents frequency and severity, drivers should be educated about the meaning of this sign. With respect to regulatory signs, sign no. 9 (NO trucks), sign no. 15 (No entry), sign no. 11 (No parking) and sign no 14 (No parking; No standing) have the lowest rates of correct answers – 31%, 35%, 36% and 38% respectively. Not

understanding or misunderstanding such signs can considerably compromise traffic safety and mobility. Similarly, for informative and guide signs, sign no. 19 (Parking is allowed) has the least corrects responses (53%). Absence of correct understanding for this sign can lead drivers seeking for parking to be in a hassle and hence generate traffic disruption especially in urban centers.

Based on the above results and consequent implications, it is crucial for local traffic agencies and relevant stakeholders to take immediate treatment measures. Ad-hoc measures can include attaching text-based panels to these low understood signs to explain their meaning. Proactive measures, in contrast, should comprise conducting extensive traffic awareness campaigns about the meaning of these signs in specific and other signs in general.

In contrast, Table 4 also indicates that pedestrian crossing warning sign, petrol station information sign, No U-turn prohibitive sign, speed hump warning sign and movement direction mandatory sign were the most correctly comprehended.

TABLE IV. DRIVERS' RESPONSES BY SIGN TYPE

No.	Sign	# Wrong	# I Don't Know	# Correct
1	W- Double bend ahead	46	69	285
2	W- T-junction on the right ahead	16	90	288
3	W- Pedestrian crossing ahead	70	4	334
4	W- Speed hump ahead	14	25	364
5	W- sharp bend ahead	221	31	152
6	W- General warning	49	45	310
7	R- Max vehicle height is 3.8m	75	67	262
8	R- Max speed is 60	49	27	329
9	R- No trucks	238	38	124
10	R- No U-turn	16	11	381
11	R - No parking	177	76	145
12	R - No right turn	154	20	229
13	R- Max. load is 20 ton	71	83	243
14	R- No parking; No standing	219	29	153
15	R- No entry	129	126	137
16	R- Only thru and RT movements allowed	62	7	339
17	R- Use the roundabout	76	12	320
18	I – Hospital is around	57	46	303
19	I – Parking is allowed	134	57	214
20	I – Petrol station is around	27	4	378

C. Socio-demographics and comprehension level

The relative impacts of drivers' socio-demographic traits on their comprehension levels are shown in Figure 1.

1) Driver's age

ANOVA analysis revealed that the age of drivers has no significant impact on their understanding to road signs meaning (p-value = 0.563). This is in agreement with Ng and Chan

(2008) and Makinde and Oluwasegunfunmi (2014). This implies that traffic sign education programs should include all age groups.

2) Driver's gender

The sign comprehensibility levels for men is not significantly different from those for women (Independent T-Test, p-value = 0.852). This is in agreement with Sodikin et al.

(2016) and Makinde and Oluwasegunfunmi (2014). Both should be educated about traffic signs.

3) Driver's marital status

Whether drivers are single, married, divorced or widowed has no impact on their sign cognition (ANOVA P-value = 0.205). Similar results were reported by Al-Madani (2002).

4) Driver's academic qualification

Academic qualification influences sign comprehension (ANOVA P-value = 0.001). The post-hoc tests using Gabriel's method reveal that drivers with BSc or higher education levels can comprehend signs noticeably better than those with lower education levels.

5) Driver's residence

The analysis also confirms that residence location affects sign comprehension (ANOVA P-value = 0.001). In specific, according to the ANOVA multiple comparison technique, drivers living in Kufa city or Najaf city have much better comprehension. The rational explanation is that it is highly expected that drivers live in urbanized area have better education opportunities than those live in less urbanized areas.

6) Driver's profession

Finally, job status also affects sign understanding significantly (ANOVA P-value = 0.01); according to the post-hoc analysis, self-employed drivers have the lowest understanding level. This could also be attributed to their expected relatively low education.

V. CONCLUSIONS

The reasonably large sample cross-sectional survey carried out for this study, the statistical-based results, and the lack of similar studies in Iraq make the findings of this study important and informative. Having that the overall drivers' comprehension level is 70.4%, it is crucial for the highway and traffic directorates and other relevant decision makers to take prompt actions. Conducting extensive and effective awareness campaigns and traffic education programs are of great importance. Priority should be given to those drivers who are low educated, self-employed and live out of cities. Similarly, those signs that have been found with low understanding levels should be given top priority. As temporary action, it is highly recommended to attach text-based panels to those low understood signs to explain their meaning.

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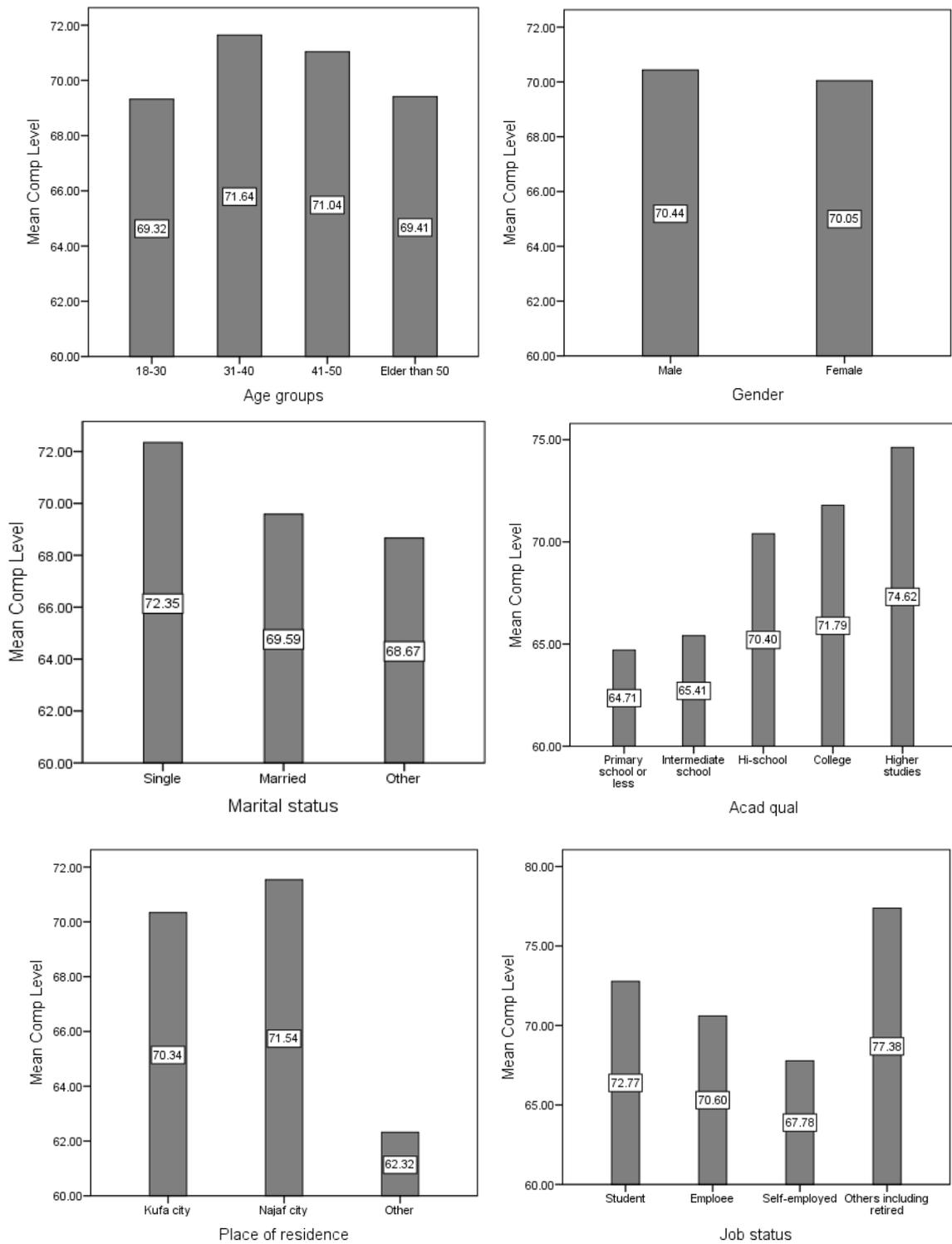


Figure 1. Potential impacts of drivers' factors on the comp level