RESEARCH ARTICLE

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Self-Assessment of Driving Abilities of Deaf and Hearing Drivers

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ABSTRACT

This research aim is to evaluate how deaf and hearing traffic participants assess their driving abilities and to determine frequency of communication, traffic violations and traffic accidents that respondents are involved in. Sample of respondents was comprised of 60 drivers, 30 deaf and 30 hearing. Qualitative and quantitative analysis was used in data processing. Self-assessment was conducted by conducting a survey about their driving abilities and abilities of the other subsample of respondents. Differences in answers were determined with t-test. Results indicate that both subsamples assess their driving abilities as very good and their driving as safe. There are differences in the safety aspect of the driving, where hearing drivers expressed some doubt about this aspect when it comes to deaf drivers. By assessing frequency of communication during driving, it has been concluded that hearing drivers communicate more often and have more involvement in traffic accidents. When it comes to correlation between frequency of communication and number of committed traffic violations, no significant differences were observed between the two subsamples. Despite self-assessment of driving ability being very good and safe by both subsamples of respondents, traffic accidents are a very frequent occurrence. Although, conversation with passengers is not prohibited, drivers should be advised to reduce it to minimum, as it has proven to be one of the significant distracting factors when it comes to driving.

Keywords: Communication, Deaf Drivers, Hearing Drivers, Self-Assessment, Traffic Accidents.

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I. Introduction

Fast lifestyle and the need for greater mobility results in greater demand for transportation. The simplest way for conducting day to day tasks, both personal and professional requires us to often use some means of transport. Driving a vehicle is a complex task of perceptual processing of information that includes perception, identification, processing and adequate response to significant information in the environment (Arthur & Doverspike, 1992). Driving a vehicle while obeying traffic regulations demands an active participation from a driver i.e., coordinated cognitive, psychological and motor effort. Driving a car is a cognitively initiated and controlled task, and thus one approach to understand driving behavior is to examine how cognitive skills are involved.

Deaf and hard of hearing persons are active participants in the traffic, whether as drivers or passengers. In the past, many discussions were held, related to deaf drivers as risk factors in traffic. Some researches have shown that deaf drivers pose greater risk in traffic (Ivers *et al.*, 1999; Picard *et al*., 2008). Such results were not found in McCloskey *et al*. (1994) and Green *et al*. (2013). According to law, drivers are instructed to utilize hearing aid while driving if a driver is deaf and in case of vehicle adaptation to person's needs, a certificate of adaptation is obligatory. Assistive technology development has provided a better warning system for deaf drivers. Harkins *et al*. (2010) studied the effectiveness of vibrotactile alerts in emergency situations and found that a longer length and temporal on-off pattern of vibration is more effective than a constant and shorter pattern of vibration. Another study considered individual's ability to detect siren sounds coming from behind them on the road.

Traffic accidents are caused by various distractions that affect drivers. Factors that affect driver's attention while driving, also affect traffic safety. Drivers face many overlapping and often competing demands on their limited information processing resources while navigating the driving environment (Silva, 2014; Metz *et al*., 2011; Regan *et al*., 2011; Young *et al*., 2007).

Decreased levels of attention are usually caused by different distracting factors such as cell phone usage and conversation with passengers. Communication while driving can be considered as one of the common risk factors. Charlton (2008) states that verbal processing of conversation results in decreased explicit

processing which in turn results in longer reaction time. The demands of each language process can vary depending on the ability, DHH individuals utilize diverse communication methods including sign language interpreters, caption writers, instants messaging, pe-and-paper writing, emails, hand gestures and hearing aids (Lee *et al*., 2019).

Aim of the research: To establish how deaf and hearing drivers assess their driving abilities and to examine frequency of communication, traffic violations and accidents those subsamples are involved in.

II. Material and Methods

A. Measuring Instrument

For the needs of this research, a measuring instrument was created in the form of a questionnaire. Before creating the instrument, consultations with target groups, deaf and hearing drivers, appropriate institutions for traffic regulations were conducted. Data was collected by direct contact with all respondents. For the purposes of communicating with deaf drivers, specialist for sign language was hired. Measuring instrument is comprised of two parts. Based on first part basic data was collected such as gender, age, time of having driver's license, driving experience, number of tickets and number of traffic accidents they were involved in. Questions related to time with driver's license, number of tickets and the number of accidents they were involved in could be answered with a number. Question about frequency of driving, respondents could select one of the following options: each day, several times a month and several times a year. Second part of the measuring instrument was created to examine respondents' self-assessments, their assessment of the opposite subsample and to examine the type and frequency of communication while driving. For verifying qualitative data, questions were scaled in Likert type questionnaire. Available answers to the statements were: 1=I agree, 2=indecisive, 3=do not agree, or 1=often, 2=seldom, 3=never.

B. Research Procedure

Research was conducted between January and May of 2022. Consultations related to rules regulations of driving tests were conducted with local authorities. Preliminary talks with deaf persons, who drive regularly, indicated presence of communication difficulties when interacting with police patrols, but no difficulties related to participation in traffic were reported. Respondents had driving licenses for motor and attached vehicles in one of the following categories: A, B, C, D, BE, CE, and DE. All respondents were interviewed individually with the method of guided interview. Respondents were first presented with the aim of the research and then their signed consent was acquired.

C. Sample of Respondents

In Table I subsample structure is shown by gender, age and duration from acquiring the license. When looking into the subsample of deaf respondents it can be concluded that there are more male respondents (86.7%), while subsample of hearing respondents was more evenly distributed amongst two genders. Duration from acquiring license had more even distribution and the most respondents had their license for 11 years (36.7%). Similar representation was shown for the frequency of driving parameter where the most respondents drive each day (80% of deaf and 83.3% of hearing drivers).

TABLE I: Subsample Structure of Deaf and Hearing Respondents in Relation to Gender, Age and Duration from Acquiring the License and Frequency of Driving

Variables		Sample			
		Deaf respondents		Hearing respondents	
		f	%	f	%
Gender	Male	26	86.7	15	50
	Female	4	13.3	15	50
Age	< 20	1	3.3	1	3.3
	21-30	4	13.3	20	20
	31-40	8	26.7	23.3	23.3
	41-50	12	40	46.7	46.7
	> 51	5	16.7	6.7	6.7
Duration from acquiring the license	< 5	3	10	5	16.7
	6-10	5	16.7	6	20
	11-20	11	36.7	10	33.3
	> 20	11	36.7	9	30
I drive	Each day	24	80	25	83.3
	Several times a week	3	10	1	3.3
	Several times a year	3	10	4	13.3

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III. RESULTS

Table II shows responses frequency on applied measuring instrument. Based on the shown representation, it can be conclude that in both subsamples of respondents, majority consider themselves a safe driver (53% deaf and 83.3 hearing respondents), while much larger percentage of deaf drivers consider themselves as very safe drivers (43.3% of deaf respondents) and only 13.3% of hearing respondents consider themselves as very safe drivers.

Differences in responses mostly occur on the claim related to frequency of communication when driving, where 70% of hearing respondents often communicate with passengers, while deaf persons communicate a lot less (36.6% never and 53.3% seldom).

According to self-assessment, both subsamples, in largest percentage, agree with the claim that deaf persons drive equally well (90% of deaf and 60% of hearing respondents) and equally safe (93.3% of deaf and 50% of hearing respondents) as their hearing counterparts.

Difference in responses occurred on the claim that relates to quality and safety of the driving in comparison to the opposite subsample. Most of the deaf drivers (46.7%) consider their driving abilities to be better and safer in comparison to their hearing counterparts but there is an almost equal percentage of deaf respondents that are unsure about this statement.

No significant differences in responses were observed when it comes to statements related to looking away from the road when communicating with passengers and using a rear-view mirror while driving. Differences were observed when it comes to statements that are related to the manner of communication and placing an additional mirror as an auxiliary tool for communication.

Table III shows the results of basic statistical parameters and the results of t-test. According to the obtained results, most deaf people agreed with the claim "Communication with passengers while driving is an issue for me because I need to look away from the road" (AS=2.61), while standard deviation indicated average deviation from the arithmetic mean in range from 0.30, "I think that deaf persons drive equally well as hearing drivers" to 0.96 for claim "Rear-view mirror does not help me enough to see rear passengers". Greatest percentage of agreement was observed in hearing drivers subsample, and it was for the claim related to peripheral form of communication while driving (AS=2.83). Standard deviation calculation indicates that the deviation from arithmetic mean ranges from 0.38 for claim related to peripheral communication to 0.84 for the claim "I drive better and safer than hearing persons".

TABLE II: RESPONSES TO THE GIVEN CLAIMS

Claims	Offered responses	Deaf respondents		Hearing respondents	
		f	%	f	%
I think I am a	Safe driver	16	53.3	25	83.3
	Very safe driver	13	43.3	4	13.3
	Dangerous driver	1	3.3	1	3.3
I talk to the passengers while driving	Often	3	10	21	70
	Seldom	16	53.3	7	23.3
	Never	11	36.6	2	6.7
I think that deaf persons drive equally well as hearing drivers	I agree	27	90	18	60
	Undecisive	2	6.7	10	33.3
	I disagree	1	3.3	2	6.7
I think that deaf persons drive equally safe as hearing drivers	I agree	28	93.3	15	50
	Undecisive	2	6.7	11	36.7
	I disagree	-	-	4	13.3
I drive better and safer than deaf/hearing persons	I agree	14	46.7	10	33.3
	Undecisive	13	43.3	9	30
	I disagree	3	10	11	36.7
Communication with passengers while driving is an issue for me because I need to look away from the road	I agree	5	16.7	3	10
	Undecisive	2	6.7	1	3.3
	I disagree	23	76.7	26	86.7
Rearview mirror does not help me enough to see rear passengers	I agree	11	36.7	5	16.7
	Undecisive	1	3.3	3	10
	I disagree	18	60	22	73.3
How do you communicate with the passengers	Rear-view mirror	26	86.7	1	3.3
	I turn towards them	3	10	5	16.7
	I only listen	1	3.3	24	80
I think that auxiliary rear-view mirror would be helpful in communication with rear passengers	I agree	21	70	3	10
	Undecisive	7	23.3	9	30
	I disagree	2	6.7	18	60

TABLE III: DESCRIPTION OF BASIC STATISTICAL PARAMETERS AND THE T-TEST

Statments		AM	SD	t-test	p
I think I am a safe/very safe/dangerous driver	deaf	1.48	0.57	1.56	0.125
	hearing	1.24	0.63		
I talk to the passengers while driving /often, seldom, never/	deaf	2.20	0.66	4.89	0.000
	hearing	1.38	0.62		
I think that deaf persons drive equally well as hearing drivers	deaf	1.16	0.45	-2.03	0.047
	hearing	1.45	0.63		
I think that deaf persons drive equally safe as hearing drivers	deaf	1.09	0.30	-3.69	0.000
	hearing	1.62	0.73		
I drive better and safer than deaf/hearing persons	deaf	1.61	0.67	-2.33	0.023
	hearing	2.07	0.84		
Communication with passengers while driving is an issue for me because I need to look away from the road	deaf	2.61	0.76	-.802	0.426
	hearing	2.76	0.63		
Rearview mirror does not help me enough to see rear passengers	deaf	2.26	0.96	-1.29	0.203
	hearing	2.55	0.78		
Way of communication with passengers /rear-view mirror, turn towards them, only listen/	deaf	1.16	0.45	-15.28	0.000
	hearing	2.83	0.38		
I think that auxiliary rear-view mirror would be helpful in communication with rear passengers	deaf	1.42	0.67	-6.06	0.000
	hearing	2.48	0.69		

AM-arithmetical mean; SD-standard deviation

T-test results are also shown and statistical significance for it is defined at the level of 0.01. Results of the t-test indicate that there is statistically significant difference in arithmetic mean when it comes to responses to claims: “Frequency of communication with passengers while driving” (t=4.89); “I think that deaf persons drive equally safe and equally well as hearing drivers” (t=-3.69); “Way of communication with passengers” (t=-15.28); “I think that auxiliary rear-view mirror would be helpful in communication with rear passengers” (t=-6.06).

IV. DISCUSSION

T-test results indicate that there are differences in communication frequency between two subsamples. Communication while driving is considered one of the frequent distracting factors. Every conversation can be considered distracting while driving. Conversation lowers driver’s situational awareness and as a result lowers ability to identify and react to potential dangers. Cell phone conversation, hands-free or not, increases risk of traffic accidents, therefore, conversation with a passenger can be considered as equally dangerous (Charlton, 2008). Sign language is most commonly used form of communication for deaf and hard-of-hearing persons and requires one or both hands as well as face pointed to the face of the interlocutor. Zodda *et al.* (2012) determined that instead of dividing their attention between driving and signing, the deaf drivers would actually alternate their attention between driving and communicating with the passenger. This indicates that deaf drivers place a greater focus on driving than on attending to a conversation.

Respondents’ stances on driving safety are considered to be directly linked to the preferred way of communication and inability to listen to sounds of warnings during driving and the sounds of their vehicle. Perception of drivers and fear of what might happen on the road, e.g. injuries, material damage and traffic violations, are largest contributors to safety while driving. Nikolaraizi and Marki (2004; 2005) state that deaf and hard of hearing respondents have more positive beliefs towards driving abilities of deaf drivers in comparison to hearing respondents, who express doubt about driving abilities of deaf drivers. Ivers *et al*. (1999) and Thourslund *et al*. (2013) did not observe such a relationship. According to Tarmey (2007), 48.8% of hearing respondents do not agree with the statement related to safe driving by the deaf persons, while 51.2% agree. In the research conducted by Brightman (2013), she states that 56.6% of hearing respondents agree with the statement related to safe driving by deaf persons, while 31.8% of the respondents disagree. Thorslund *et al*. (2013) have, in a simulator study where they examined driving characteristics of deaf and hearing persons, concluded that deaf persons look into the rear-view mirror in more frequent and shorter intervals and more often control the road in comparison to their hearing counterparts which, in combination with lower driving speed, indicates more vigilant driving pattern. According to Lee *et al*. (2014), hearing drivers consider deaf driver as a safety threat. They state that even though most insurance companies consider deaf persons as safer drivers than hearing persons, hearing persons say letting deaf people drive is not safe because deaf drivers cannot hear audible cues such as police siren an ambulance needing the right of way, or even a honking horn. Because of this, deaf people get discriminated and some are not even allowed to drive at all.

Differences obtained by t-test, for statements related to peripheral form of communication and easier communication in case of having an auxiliary rear-view mirror for better view of an interlocutor, are logical

and expected. The most commonly used form of communication by hearing persons is oral speech, while deaf people use sign language or simultaneous communication.

Fig. 1 indicates differences in communication frequency between deaf and hearing drivers, as well as differences in form of communication used by subsamples of respondents. When it comes to accidents, most of the deaf respondents (66.7%) never had an accident while 33.3% of them had less than 5 accidents. A larger percentage of accidents was recorded for hearing respondents, where 46.7% were accident-free, and the same percentage for respondents that had less than 5 accidents. In hearing subsample, 6.6% of the respondents have had more than 5 accidents. Differences in frequency of traffic accidents have proven to be statistically significant, t-test=1.915 (df=58).

Research has shown that deaf persons utilize different cues, such as feeling for acceleration or vehicle vibrations, for speed control and safety while driving. There were no statistically significant differences for number traffic violation tickets, but subsample of deaf respondents had more traffic violation tickets (<5=66.7%) in comparison to the hearing subsample (<5=50.1%).

Considering shown data, we can conclude that there is a greater frequency of traffic accidents for hearing subsample, and when it comes to traffic violation tickets both subsamples are tied. Thourslund (2013) indicate that drivers with hearing loss have developed coping strategies to avoid distractors or to compensate for their hearing loss, or a combination of the both. Some studies suggest an association between hearing loss and increased risk of traffic accidents (Picard *et al*., 2008). However other studies show no such relation (Green *et al*., 2013). Schmolz (1987) examined the importance of hearing for road users and found that hearing loss is associated with a higher degree of inattention. With regard to attention, Hickson *et al*. (2010) showed that hearing loss in older drivers was associated with poorer driving performance in the presence of distraction, but not without distraction. On the other hand, Pickard *et al*. (2008) suggest that hearing loss leads to a reduction in speeding violations, probably due to self-regulation.

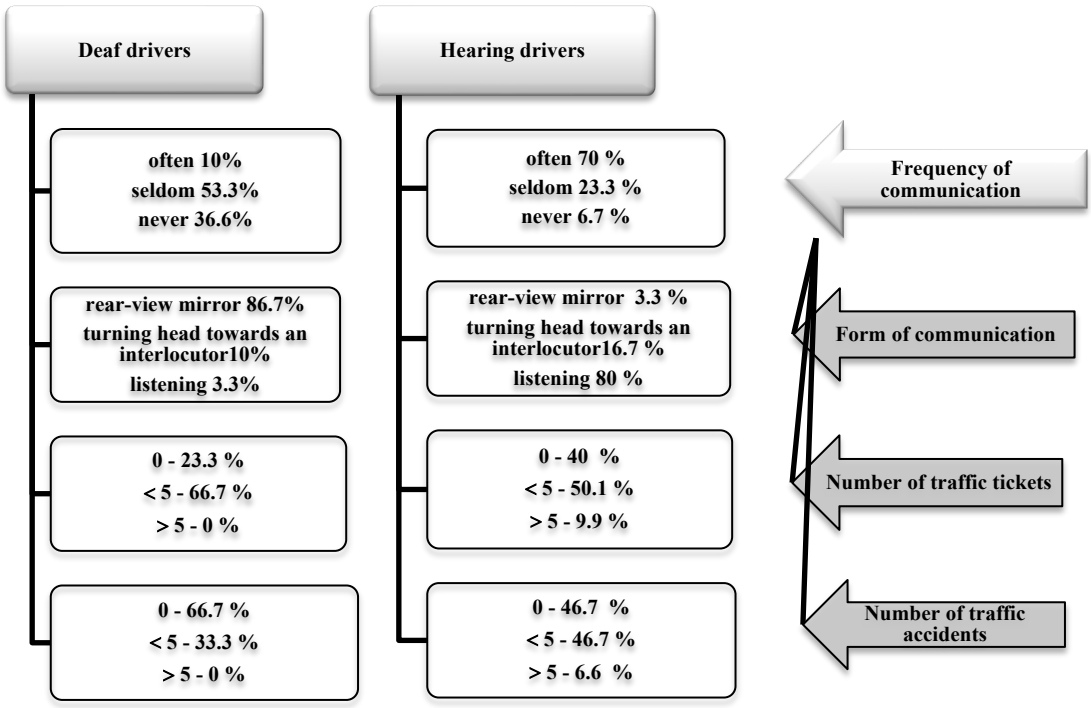

Fig. 1. Graphical representation of frequency and form of communication, traffic accidents and violations.

V. Conclusion

Research results indicate that both subsample of respondents assess their driving abilities as very good, and their driving very safe. Statistical analysis was used to determine the differences in the assessment of driving safety of deaf persons, where hearing drivers express doubt of this aspect of deaf persons' driving. Considering that deaf persons have equal intellectual, physical and mental capabilities, this opinion can be attributed to prejudice and lack of knowledge. This attitude can result in lower mobility of deaf persons and therefore lowering quality of life for this population. Regardless of the self-assessment of driving abilities, traffic accidents are a frequent occurrence. Evaluating frequency of communication while driving, we concluded that hearing drivers communicate more often and have greater frequency of involvement in traffic accidents which proved to be statistically significant. When it comes to connection between frequency of communication and traffic violations committed, no significant differences were observed comparing two subsamples.

CONFLICT OF INTEREST

The authors do not have any conflict of interest.

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