Journal of the Society of Automotive Engineers Malaysia
Vol. 1, Issue 1, pp 33-40, January 2017

Hazard Perception: Does Experience Matter?

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ORIGINAL ARTICLE **Open Access**

Article History:

Received
1 Nov 2016

Received in revised form
1 Dec 2016

Accepted
15 Dec 2016

Available online
31 Jan 2017

Abstract – *Hazard perception is a critical skill in driving. Without which, drivers have high chances to get involved in crashes. Previous study in literature highlighted that hazard perception test may not be a suitable diagnostic tool in distinguishing novice and experienced drivers. Current study aimed to replicate this finding, but involved drivers with more experience than the one in literature. The results revealed that while both less- and more-experienced drivers are identical in terms of reaction time to hazards, the former group recognised less hazards than the latter.*

Keywords: Hazard perception, experience, age

Journal homepage: www.journal.saemalaysia.org.my

1.0 INTRODUCTION

Road injury is among the top five principal causes of death in Malaysia for the past two decades (Haagsma et al., 2016). In 2013, number of fatalities on Malaysian roads was worryingly 6,915 from 477,204 reported crash cases. While the trend of fatalities on road post year 2000 was less aggressive relative to years before that, Rohayu and her colleagues predicted that this trend would worsen if no efficient intervention takes place (Sarani et al., 2012).

Malaysian government has taken many steps in dealing with this issue. One of them is via education to the drivers: In 2000, Road Transport Department has announced the use of Driver Education Curriculum in drivers' training system (Mohd Jawi et al., 2015). The curriculum, later revised and enhanced in 2007, put more emphasises on hazard perception and reaction relative to the previous curriculum. This is because, hazard perception is one of critical skills that competent road users should have.

Many studies have shown links between the ability to perceive hazards with crash involvement: Congdon (1999) reported a significant association between hazard perception test score with police reported-crashes; Wells et al. (2008) showed a significant association between hazard perception test score during licensing with self-reported "non-low-speed" crashes within the first year of driving; Darby et al. (2009) outlined that besides attitude, behavior and knowledge, hazard perception is also highly correlated with self-reported collisions; Horswill et al. (2010) reported an empirical association between hazard perception

and crash involvement; Boufous et al. (2011) demonstrated that, relative to drivers who passed hazard perception test on the first attempt, drivers who failed the test at least twice had an increased risk of crash; further, in contrast to accident-free riders, Cheng et al. (2011) reported that accident-involved riders involved with higher driving violation and took longer to identify hazardous situations; and the more recent, Horswill et al. (2015) demonstrated that drivers who failed hazard perception test were more likely to be involved in crash within the first year after the test.

In fact, hazard perception test has been incorporated as a compulsory component of driver licensing in certain countries like United Kingdom, Australia, and Netherlands because of its utility in reducing accidents among new drivers. In Malaysia, even though it is part of the curriculum, a specific test for hazard perception is not yet part of driver licensing component. Thus, if the government would like to go onto similar path with the countries that have adopted hazard perception test in their licensing programme, the consequent question would be on whether such test is suitable for Malaysia. In other words, can hazard perception test becoming a good diagnostic tool in distinguishing safer drivers from the rest. While this is the underlying philosophy of the test in the United Kingdom, a cross cultural study between Malaysian and UK drivers revealed that reaction time based HPT failed to distinguish between experienced and novice Malaysian drivers (Lim et al., 2013). To the best of authors' knowledge, this is the only published study of hazard perception involving Malaysian samples.

Lim and colleagues explained this inconsistent finding, relative to other previous studies who reported experience matters in hazard perception test (Wetton, 2010), by positing that their samples of experienced drivers did not have enough experiences. While their experienced samples have an average of four years of driving license, other studies supporting the influence of experience on hazard perception involved with samples whose licensing experience was about ten years. This brings up another question: what is the length of driving experience that is required for a good hazard perception skill?

Before concluding on the incapacity of response-time based hazard perception test in distinguishing between experienced and novice Malaysia drivers, we would like to argue on using years of licensing as the measure for driving experience. There are ambiguities attached to this measure. For instance, there could be drivers with years of licensing but the actual exposure on the road is less. Also otherwise, there could be drivers who were driving years before having a legal driving license. Therefore, this study aims to replicate Lim et al.'s work, but included various measures of experiences – i.e. actual driving months (regardless of licensed or not), average kilometre on the road per day driving, as well as age as the biological indicator of experience.

The present study adopted the common reaction time based hazard perception test: participants seated in front of a screen watching movie clips of normal driving recorded from driver's point of view. While watching they have to make a response on hazards appeared on the screen. Reaction times of the responses were captured for analysis. Participants for this study involved two groups: less experience vs. more experience car drivers.

With wider range of driving experiences among the experienced drivers in this study, we predicted that hazard perception test could distinguish between these two groups of drivers. In other words, relative to less experience drivers, more experience drivers should recognizing more hazards, and response to it faster.

2.0 METHODOLOGY

2.1 Participants

The study involved two groups of drivers: less experienced (N = 29) and more experienced (N = 28) drivers.

2.2 Hazard Perception Test

The in-house developed hazard perception test software employed reaction time paradigm, similar to other studies (Chapman & Underwood, 1998; Horswill & McKenna, 2004; McKenna et al., 2006; Sagberg & Bjørnskau, 2006; Wetton et al., 2011). The test included 20 hazards for drivers presented in 12 short clips accumulating to 415 seconds short video. These clips were recorded in high-definition mode on local vicinity during daylight hours, in most of the time under clear sky. While replaying the videos, and when participants clicked on the screen, the software captured the frame, and superimposed the position of the mouse, and time on top of it. This image, along with the clicking time and mouse position was stored for later analysis.

2.2 Analysis

The analysis of the data focused on two variables – hazard recognition, and hazard reaction time – across two groups of participants. Hazard recognition index captures whether participants perceived the presented hazard as hazardous. The ratio of hazard responses relative to 15 hazards in the video constitutes the index. The second focus of the analysis zooms onto the reaction time towards the hazards. The reaction time from the clicking was compared with reference time for each hazard, i.e. the time when the hazard starts to develop. In this focus, the smaller the difference between clicking and reference time, the better.

2.2 Procedure

The test began with participant candidates consented to participate. Then they sat in front of a computer screen and made themselves comfortable. Then the researchers explained to them that the task involved watching a video (see Figure 1 for a snapshot of the video), and they need to identify any hazard by clicking on the screen. In addition, researchers also mentioned to them that there could be clips without any hazard, of which they had not need to click. To combat random clicking, they learned a bogus warning that any incorrect clicking would panelise their score. Before beginning the test, they watched a sample video, and had opportunity to practice clicking and familiarised themselves with the instruments specifically the mouse. After completing the task, participants reported their age, exposure on the road including average kilometre on the road per day, and real driving experiences including the years of driving without license. Participants dismissed the lab after debriefing session.

3.0 RESULTS

3.1 Characteristics of Participants

Table 1 entails descriptive analysis of both groups. In average, relative to more experienced, less experienced drivers were younger, had less driving experiences, and spent less kilometre on the road per day.

Table 1: Descriptive analysis of participants' characteristics

	Mean (SD)	
	Less Experienced Drivers, N = 29	More Experienced Drivers, N = 27
Age (month)	260.31 (21.93)	409.63 (97.00)
Real driving experiences (year)	2.16 (2.12)	15.26 (7.04)
KM per day	11.62 (11.24)	126.59 (63.60)

3.2 Hazard Reaction Time

Qualitative observation on histogram in Figure 2 reveals similar distribution of average reaction time. The mode of average reaction time in both group fall into 2.00 – 2.25 seconds range. Mean of reaction time for less experienced, M = 2.47 (SD = .74) was marginally slower than and more experienced drivers, M = 2.40 (SD = .632). In contrast, median of reaction time for the former group was faster, Mdn = 2.18 than the latter group, 2.26 seconds. An Independent Sample t-Test further indicated that no significant difference of reaction time between the two groups, $t(54) = .38$, $p = .704$.

3.3 Hazard Recognition

Histogram in Figure 3 exposes that more experienced drivers performed better as a group in recognising hazards. The modes and medians of total hazard recognised for more experienced group is 16, which is two hazards more than less experienced group. Further, the mean of hazard recognition for the former group was M = 16.63 (SD = 1.80), while the latter group scores M = 13.90, (SD = 2.37). An Independent Sample t-Test on the data revealed a significant difference of hazard recognition between less and more experienced drivers, $t(54) = 4.84$, $p < .001$.

Figure 1: A snapshot of a video showing a truck on the left is about to move into the main road

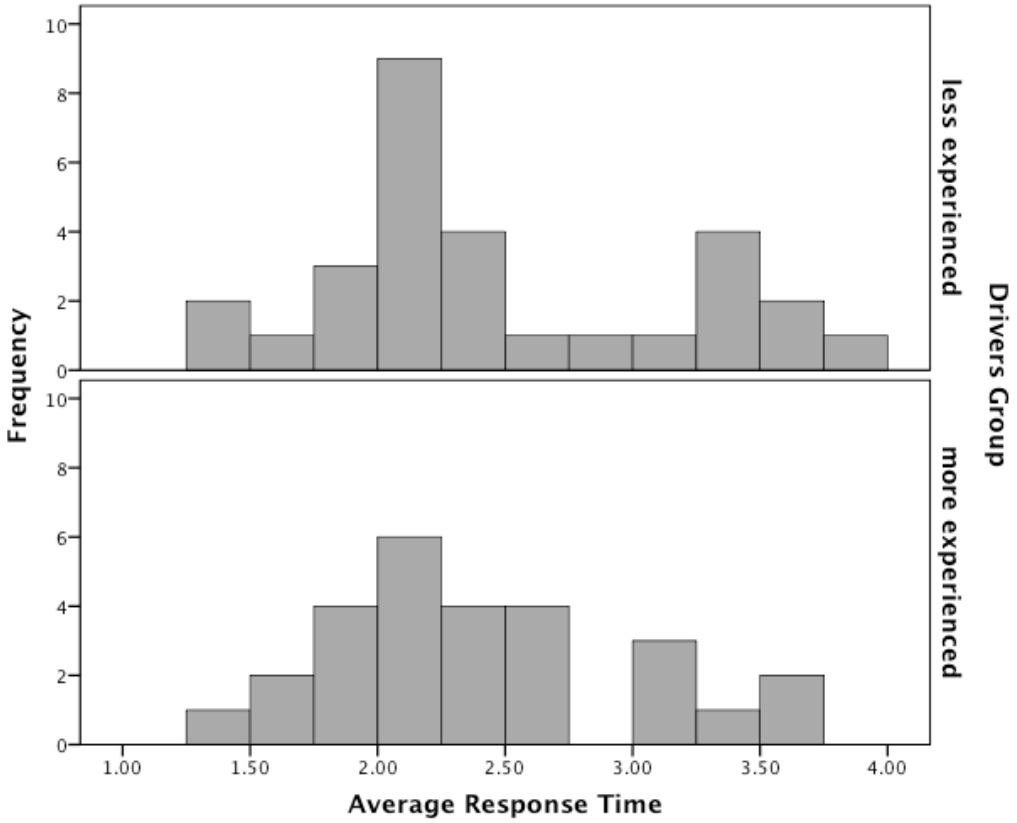

Figure 2: Histogram of reaction time for both groups of drivers

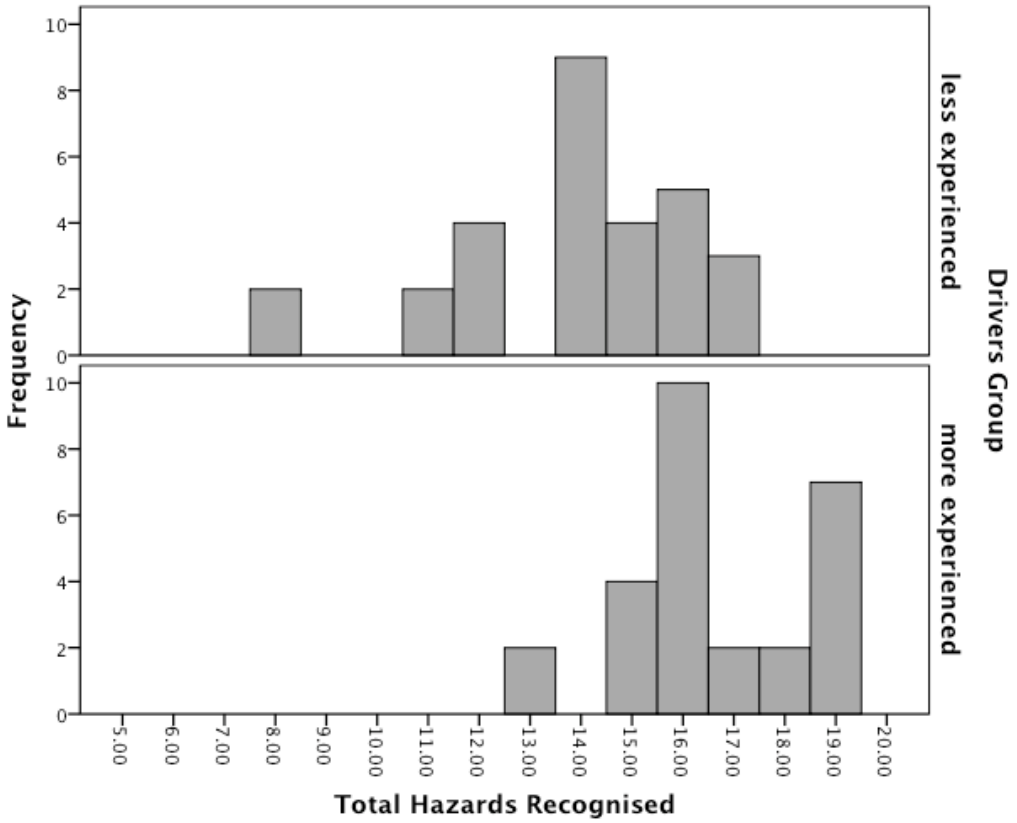

Figure 3: Histogram for hazard recognition for both group of drivers

3.4 Influence of Age, Experience, and Exposure on Hazard Perception

Table 2 summarises the correlations between variables in the study. Age, experience on road, and kilometre per day have no significant relation with average reaction time, but positively correlated with total hazards recognised.

Table 2: Results of correlations between hazard perception, age, and exposure

	2	3	4	5
1. Total hazard recognised	-.585*	.422*	.429*	.388*
2. Average reaction time		-.075	-.068	.007
3. Age (months)			.962*	.540*
4. Experience on road (years)				.597*
5. KM per day				

4.0 DISCUSSION

In this study, we contrasted the performance of less- and more-experienced drivers on hazard perception test. Two measures from the test are reaction time (i.e. the time taken to recognise hazard), and total number of hazards recognised.

Similar to the results of Lim et al. (2013), the results of our study also show that reaction time is not a reliable proxy measure of hazard perception when distinguishing between more- and less-experienced drivers. In contrast, results of our study show that less-experienced drivers recognised lesser hazards than their more-experienced counterpart, which Lim and colleagues did not find.

In their article, Lim and colleagues postulated that the inefficiency of reaction time based hazard perception test could be due to drivers in Malaysia may be desensitized to hazardous road situations. Consequently, they have higher hazard threshold for what constitute a hazard and thus increased response latencies during the test. Additionally, they also argued that the higher hazard threshold might supersede any differences between less- and more-experienced drivers.

While current study's results recline to support the former argument, it defers the latter. Current study's positive results (i.e. the difference of total hazards recognised between less- and more-experienced drivers) indicate that regardless of higher hazard criterion, it does not completely supersede the differences between these two groups of drivers as Lim and colleagues presumed. This is because, while both groups of drivers may be equally desensitised by many hazards on the Malaysian road, resulting for slower response time, their thresholds of what constitutes for hazard are still distinguishable: less-experienced drivers recognised more things less hazardous than more-experienced counterpart. This suggests that, relative to reaction time, the total number of hazards recognised is a better proxy measure of hazard perception for drivers in Malaysia.

A possible explanation for the inconsistency between our results and Lim et al.'s results may be due to the definition of 'more-experienced' drivers (or 'experienced' in their study). In current study, the mean of more-experienced drivers is 15.3 (*SD* = 7.04) years, relative to 49.4

months in their study. When driving, drivers form association between hazard precursors and its actual occurrence. The knowledge formed from this associative learning process plays a critical role in prediction, and elemental when drivers are trying to perceive hazards in novel situations. Current study demonstrates not only that experience matters when perceiving hazard, but also highlights that the number of years/months on the road influences the level of hazard perception competency. Consequently, the next question in line would be on how many years do drivers need to be on the road to be good in hazard perception?

Another noteworthy finding from current results is that, reaction time is not only independent with years of licensing, as Lim and colleagues reported; but also with age and experience on the road. Likewise, the argument is applicable to total number of hazard recognised. One possible reason for this could be due to high interrelation among these three variables: of course, older drivers are more likely to have license earlier, and spend more time and exposure on the road.

Hazard perception is an important skill when driving. With the fertile emergence of technologies towards autonomous driving, an emerging question would be whether hazard perception skill still matters in future? While these technologies offer promising solutions to road safety problems, users' acceptance is a non-technological challenge that is yet to be addressed (Md Isa et al., 2015). To tackle this human nature of reluctances and sceptics, the implementation of these technologies takes place rather gradual with the introduction of partial or semi-autonomous driving technologies in current latest models. While this may seem a good start, it raises a potential issue of compensatory behaviour: "*even though my hazard perception skill is poor, I can still drive because my car is highly equipped with sophisticated sensors and equipment.*" Problematic indeed. Perhaps, only after a complete surrendering of driving to technology would road safety become irrelevant. At that time, fallible, emotional, and bias susceptible human would no longer in control behind the wheel; and what would matter then?

5.0 CONCLUSION

Experience matters to hazard perception. While both groups of drivers performed equally quick (or slow) on responding to the hazard, the more-experienced drivers spotted more hazards than their less-experienced counterpart. Investigation of the mechanism of experience influencing hazard perception performance is worthy, and should be the focus of future research, for development of effective intervention plan.

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