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Hazard perception of motorcyclists and car drivers

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ABSTRACT

The current study compares hazard perception (HP) performance of 50 male drivers with and without a motorcycle license in order to generalize results. A video-based HP test, measuring reaction times to traffic scenes, was administered to these two groups of drivers. Participants with a motorcycle license performed better than participants without a motorcycle license. ANOVA indicated that learning improved linearly for participants with a motorcycle license but not for participants without a motorcycle license. No evidence that HP was predicted by age was found. HP scores for drivers who reported previous involvement in an accident were lower than for those who reported not being involved in an accident. The results are discussed in the context of sensitivity and response bias models.

1. Introduction

Motorcycle riders have especially high rates of injury in the USA (NHTSA, 2007) and in many other countries (for example, in Israel, National Authority of Road Safety, 2008). Potential harm is greater for motorcyclists and their passengers than for vehicle drivers since they are not protected by the metal structure of a vehicle (Shu-Kei Cheng and Chi-Kwong Ng, 2010).

Haque et al. (2009) showed that motorcycle drivers are at fault in a number of critical situations, in particular, high speed riding on expressways, riding with pillion passengers on expressways, and riding on wet-road surfaces. These findings are the basis for the rationale of the current study, aimed to better learn the capacities of motorcyclists to cope with dangerous traffic situations compared to those of car drivers.

Mannering and Grodsky (1995) give several reasons why the characteristics of motorcycle accidents differ from those of other vehicles. First, they claim, car drivers “tend to be inattentive with regard to motorcyclists and have conditioned themselves to look only for other [cars] as possible collision dangers.” Second, they claim that motorcycle operation is typically a more complex task than driving a car, requiring excellent motor skills, physical co-ordination and balance. Motorcycle riding also involves counterintuitive skills such as “counter-steering, simultaneous application of [mechanically separate] front and rear brakes, and opening the throttle while negotiating turns.” Riding behaviors that have been found to increase crash risk include riding too fast (e.g. Lin et al., 2003; Wells, 1986), drink-riding (e.g., Fell and Nash, 1989; Lin et al., 2003), poor observation as well as poor signaling at junctions (e.g., Wells, 1986).

Since motorcycle riders are subject to specific hazards in addition to those that they have in common with car drivers, this article is concerned with hazard perception of motorcyclists as compared to car drivers.

For car drivers, anticipation of hazardous traffic situations is perhaps one of the major contributions to driver safety, although Sagberg and Bjørnskau (2006) concluded that hazard perception is probably only a minor factor in explaining the initial risk decrease among novice drivers. A hazard is defined as any permanent or transitory, stationary or moving object in the road environment that has the potential to increase the risk of a crash (Haworth et al., 2005). Hazard perception is defined as “the process whereby a road user notices the presence of a hazard” (Haworth and Mulvihill, 2006). Since hazard perception predicts crash risk (Haworth and Mulvihill, 2006), it is justified to emphasize it in order to reduce injury in road crashes. The current study focuses on hazard perception of motorcyclists and car drivers.

Hazard perception is a multi-component cognitive skill that can improve with experience (Deery, 1999). This set of skills, usually measured by the Hazard Perception Test (HPT), was found in previous studies to be better in experienced drivers (Crundall et al., 1999, 2002; Horswill and McKenna, 2004; Sagberg and Bjørnskau, 2006). Furthermore, Smith et al. (2009) found a significant interaction between sleepiness and experience, indicating that the hazard perception skills of the more experienced driver was relatively unaffected by mild increases in sleepiness while in the inexperienced driver, the skills were significantly weaker.

As hazard perception has been considered an important component of safe driving, the performance of motorcyclists on the HPT was tested and compared to that of car drivers. Motorcycle riders

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function differently from car drivers in hazard perception as well as in other traits. In particular, in a study by Horswill and Helman (2003), participants completed a battery of video-based tests of driving behavior and performance in a video-based car or motorcycle simulator. In the HPT, participants were shown various road situations and asked to push the reaction key as rapidly as possible when they detected a potentially hazardous situation developing on the road in front of them. The motorcyclists succeeded better in the hazard perception task than the car drivers. While this advantage was obtained when they were imagining they were driving a car, it was not present, however, when they were asked to imagine they were on a motorcycle.

Horswill and Helman's (2003) conclusion was that the influence of motorcyclists' behavior on their accident risk is small. Due to the increasing involvement of motorcyclists in road crashes (Broughton et al., 2009), we believe it is important to explore more about the different HP patterns of motorcyclists compared to those of car drivers.

The current study focuses on this issue involving a different test as well as participants from a different country with different characteristics in order to obtain a higher degree of generalization of the results of Horswill and Helman's study (2003).

2. Method

2.1. Participants

Fifty male drivers, students in the Rishon Letzion College in Israel, recruited through advertising in a student internet site, volunteered to participate in the study (mean age = 27.4; S.D. = 3.0 range = 21–31). Half of the participants had a motorcycle license (mean age = 28.5; S.D. = 3.2) and half of the participants did not (mean age = 25.9; S.D. = 3.2). All the participants had a vehicle driving license. The two groups did not differ either in their family status or in number of children [$\chi^2 = 0.39$, $p > .1$; 0.14, $p > .1$, respectively]. The information obtained came from self-reports and most of the participants were Israeli-born, their residence was in the center of the country, and they were all in good physical condition.

2.2. Instruments

Two instruments were used for this test:

1. *The Hazard Perception Test*. This test was developed for training purposes for novice drivers, not yet in use as an official test that all drivers must complete to gain a driving license. Bearing resemblance to the tests used in the UK (Driving Test 2007/08), this test consisted of 10, randomly presented 1-min video clips containing naturally occurring traffic situations. Any situation which could potentially develop into a hazard was considered a critical situation in the test. The situations included daylight vs. nighttime, rainy vs. sunny weather, etc. All the participants were exposed to the same clips, although in different random order.

Some clips show a sudden occurrence, such as a pedestrian running into the road or a vehicle making a sudden turn without warning, a traffic light turning red or a vehicle suddenly switching from one lane to another. When the participant notices the oncoming danger, s/he has to click on the mouse. Each click on the mouse is registered. During the test, the participant does not receive feedback about misses or hits. S/he gets a score from 1 to 5 (where 1 is low and 5 high) after each clip. This score is determined by (1) the time reaction to the danger measured by the click of the mouse (2) a false alarm – clicking the mouse in a non-danger situation and (3) missing the danger, measured by not clicking the mouse when expected.

Test Scoring: The Hazard Perception Test includes 14 (of which we presented 10) driving video clips viewed from the driver's point of view. Each of the clips contained a transportation situation that required either slowing down, stopping or lane changing due to the hazard presented. The subjects were asked to indicate these hazards by a mouse click. Most of the video clips contain one hazard only. One of the video clips contains two hazards (and participants are informed of such). There is no indication which of the video clips contains the double hazard. This means that participants must watch every video from start to finish and not “lose interest” once he thinks he has spotted the hazard. Each video clip lasts around 1 min.

As each video clip has been carefully analyzed, the exact moment when the hazard can first be spotted is recorded. At the other end of the scale, the last possible moment when the driver could be seen as having reacted to the hazard “in time” is recorded as well. Depending on the clip, this time frame can vary in length from a second to 10 s or more. The clip is divided up into 5 equal-length scoring sections. If the participant responds to the hazard in the first of the 5 sections, he scores 5 points. If participant responds in the second of the time segments, he scores 4 points, and so on.

There is no upper limit on the number of times a participant can click during a clip but the software contains an algorithm to detect and eliminate “cheat” clicking. The software monitors for patterned, rapid and numerous clicks. Candidates who try to cheat by clicking once a second throughout a clip will not get any points for that video clip and will receive an on-screen warning. The Cronbach's alpha of the test is .8434.

2. *The Demographic Questionnaire*. This questionnaire contained 22 questions concerning age, gender, marital status, residence and details about the participant's driver's license (vehicle and/or motorcycle), ownership of the vehicle and/or a motorcycle, responsibility of involvement in accidents and fines received from the traffic police.

2.3. Procedure

The participants were invited to a session of the Hazard Perception Test (HPT) at the College of Management in Rishon Letzion and at the Institute of Technology in Holon. They filled out the abovementioned questionnaire, after which they each took the Hazard Perception Test.

Participants were exposed to the HPT after being briefed about the task, as detailed above. Hazardous situations were defined as any situation where the driver needed to suddenly brake or execute any other maneuver to avoid a collision. Scores for each test were calculated by two parameters: (1) Response time after the appearance of a precursor of a critical situation (participants were given higher scores for faster responses). (2) In case of a false choice (responding without a hazardous event), the participant lost points.

The Score Sheet. All 10 scores were registered for each participant individually.

3. Results

The means of the HPT score were submitted to an independent sample *t*-test in order to investigate the prediction that the motorcyclist would perform better in the HP test. As presented in Table 1, motorcyclists indeed performed better. We also found that this pattern of results was true when we performed the analyses separately for different age groups (22–27 years vs. 28–30 years), for participants that had been involved in an accident vs. participants that had not been involved in an accident, for participants that received fines (one or more) vs. participants who received no fines, and for differ-