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Effect of driving experience and driving inactivity on young driver's hazard mitigation skills

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ABSTRACT

Driving skills is an accumulation of driving skills learned from training which are further developed through post-licensure on-road driving. A key driving skill is handling interaction with other road users, of which a critical component is mitigating hazards in order to avoid a crash. Driving skills learned through training during licensure degrade over time if the driver never progresses onto on-road driving (i.e. case of inactive driver). Inactive drivers are quite common in Singapore due to high car ownership cost resulting in many people in the population holding a valid driving licence, but yet having limited opportunity to drive. This research investigated the effect of on-road driving experience as well as driving inactivity on driving performance in terms of hazard mitigation. A sample of 91 participants with a range of driving exposure drove on simulated driving environment in the laboratory. Response latency and its constituent components (lag time, time to fixation and perception-response time) in hazards mitigation were used as driving performance indicators. Participants who are active drivers responded faster than inactive (novice and dormant) drivers. Driving training (during licensure) seemed to play only a small role in preparing drivers for hazard mitigation. On-road driving exposure played an important role to strengthen skills in mitigating hazards. Defensive driving course may help drivers to strengthen their driving competencies especially towards responding to hazardous situations.

1. Introduction

Driving a vehicle is a complex task that combines many sub-tasks such as control, guidance, and navigation (AASHTO, 2010). Vehicle handling skills constitute an important aspect of driving activities to safely navigate and control the vehicle. Familiarity with the driving process that is developed through training (during licensure) and post-licensure on-road driving affects the driving skills of a driver. Key driving skills include speed control, lateral placement control, hazard mitigation etc. In essence, a person's driving skill is a combination of driving skills that are learned during driving training, and further driving skills that are acquired through on-road driving exposure. Driving training serves to develop basic driving skills of a person and familiarise him (both genders) with the driving task and road rules, in order to prepare him to drive on public roads. On-road driving exposure further develops the driver's skills as well as familiarisation with real-world driving conditions.

Previous studies showed that driving experience can influence the visual behaviour of drivers (Borowsky, 2006; Deery, 1999; Konstantopoulos, Chapman, & Crundall, 2010). While novice drivers tend to focus their eye gaze on a narrower area

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of the visual field, more experienced drivers scan a wider area which thus affects hazard identification. Crundall, Underwood, and Chapman (1999) pointed out that an experienced driver is better at detecting peripheral object than a novice driver and a non-driver. Their findings suggested that experience can develop perceptual skills and strategy that lead to a more efficient functional field of view. On-road driving exposure also improves driver's perception of risk and his awareness about possible on-road hazardous situations (Borowsky, 2006; Sagberg & Bjornskau, 2006). Borowsky (2006) found that young-inexperienced drivers are more reactive toward hazards, while experienced drivers are more proactive and preventive towards hazardous situations. Fisher et al. (2002) have shown that experienced drivers have a better awareness and also anticipations. Other than road experiences, PC-based and driving simulator training have been found to be effective tools to improve the risk awareness of young drivers and their visual scanning (Fisher, Narayanaan, Pradhan, & Pollasteck, 2004; Pradhan, Pollatsek, Knodler, & Fisher, 2009; Vlakveld et al., 2011).

In Singapore, the cost of having a private car is extremely high (amortised capital and operating cost for a small saloon car is of the order of US$ 800 $\sim$ 1200 a month). Therein, there are many people in the population who hold a valid driving licence, but with limited opportunity to drive due to limited access to a private car. The population of Classes 3 and 3A driving licence holders (to drive a private car) increased from 1,686,272 in 2011 to 1,913,161 in 2015, or 13.5% increase in five years (Singapore Police Force, 2017b). However, private car population remained fairly static over the same period, at 725,484 units in 2011 and 724,586 units in 2015 (Land Transport Authority, 2017). This is a rather unique characteristic in Singapore of the driving licence holders' population. In effect, many licence holders have never driven or rarely ever drive since getting their licences.

Singapore has a systematic driving licensure procedure comprising a theory test followed by a practical driving test (Singapore Police Force, 2017a). The learner must first pass the basic theory test before he can advance to practical driving lessons (in-vehicle driving training). Practical driving lessons are conducted with instructors from authorised driving centres or accredited private instructors. After undergoing sufficient instructor-guided training, only then the learner can sit for the driving test. The practical lessons entail 30–50 h of in-vehicle driving training over a period of 2–3 months, and it is also the first time that most learners in Singapore ever handle the car. The practical lessons include training sessions on public roads. For the driving course (for licensure), the driver is trained in vehicle handling skills and the driving rules, which include safety procedures (look-out for hazards) and emergency stop. Safety procedure lesson is meant to teach drivers the proper procedure to avoid any hazardous situation that can occur on the road. Emergency stop lesson is meant to prepare driver to react properly when involved in hazardous situation to avoid accidents.

The driving licensing process distinguishes fit-to-drive drivers from the unfit-to-drive ones. This is one of the ways to improve safety by not letting an unfit-to-drive person to be driving on the road. While previous studies have shown that driving experience indeed improves one's driving skills, on the opposite, the skills and familiarity with the driving task and on-road situations may degrade over the time if a driver never have the opportunity to drive regularly. Previous studies in the fields of sports have shown that physiological condition and performance of an athlete can be deteriorated due to reduced practice and total rest from practice (Garcia-Pallares, Carrasco, Diaz, & Sanchez-Medina, 2009; Neufer, Costill, Fielding, Flynn, & Kirwan, 1987). Meanwhile, several studies in military field have also shown that there shall be deterioration in skills such as perceptual-motor skills (Ammons et al., 1958; Fleishman & Parker, 1962) as well as cognitive and memory skills (Wisher, Sabol, Ellis, & Ellis, 1999), if there is no opportunity to practice after obtaining the skills. A study by Hampton (2016) shows the deterioration of manual flying skills of pilot due to automation of the cockpit. Increased automation of cockpit control has caused pilots to use their manual control skills less frequently. Furthermore, different types of skills may have different deterioration rate (Farr, 1987; Wisher et al., 1999). This situation could also inflict on driving skills retention. To our best knowledge, there is yet no study on the effects of driving inactivity on driving skills, specifically on hazard mitigation skills. Therefore, this research aims to investigate the effect of driving inactivity as well as on-road driving exposure on driving performance, in particular on hazard mitigation.

2. Methodology

2.1. Test subjects

Participants were drawn from the student population at the Nanyang Technological University (NTU) for which a sample of nearly 100 participants were recruited. The age of the participants ranged from 20 to 30 years old. The participants include people with normal and corrected eyesight, but not those with other vision problems such as cataract and glaucoma. For participants with corrected eyesight, participants were asked to wear their own contact lenses. Alternatively, snap-on lenses were available to be attached to the eye tracker glasses according to the requirement of each participant. During calibration, a check was also performed to ensure that the participant can see well with the snap-on lenses.

Before any experimental work, these subjects had to sign pre-approved ethics review protocols which ensure that test subjects voluntarily participated in the experiments. The subject can stop the experimental run at any time if he feels unwell at any stage of the experiment. Some data were excluded from the analysis, due to error on the eye tracking device, which thus reduced the sample to 91 subjects.

Participants were grouped into four groups based on their possession of driving licences and their driving activities. These four groups are active group, novice group, inactive group and no licence group. Table 1 shows the detailed description of