MITSUI SUMITOMO INSURANCE WELFARE FOUNDATION (MSIWF)
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REPORT OF RESEARCH RESULTS
REPORT OF UTILISATION OF RESEARCH GRANT

Title:
Ageing population and road safety – A driver's perspective

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1. Summary:

Ageing population is a critical issue in many developed economies. One of the implications is the increasing age of drivers. A review of the literature suggests that novice and elderly drivers are overrepresented in road traffic accident. However, a causal relationship is yet to be established due to varying driving patterns. This project, through a laboratory-based video simulation experiment, examined the perception time, reaction time, and total response time of 64 driver subjects of varying ages. In general, older drivers took a longer time to visually detect the onset of road hazards, while no significant age effects are found on reaction time and total response time, though the mean reaction time of older drivers appears to be shorter. This suggests that crash risk of various driver age groups depends on the type of incident and availability of response time. In addition, subjects opined that minimum driving age should be decided based on driver maturity, while factors considered for maximum driving age are reaction time, eyesight, and health conditions.

2. Aim:

This 12-month project is aimed at developing a better understanding of the dynamics behind the associated crash risks for older drivers, and recommend solutions (as applicable) for improving road safety for older drivers. In particular, the information processes are disaggregated into the sensory and cognitive aspects.

3. Method of Research & Progression:

Phase I: Literature review (Jan-Mar 2013)

This phase involved reviewing the existing literature on age-relative driving and accident risks. The literature review reveals that crash rates are the highest for both the youngest and the oldest driver groups. Older drivers' crashes mostly involve intersections and failure to give way. Drivers in the middle age group appear to have the lowest accident risks. It was found that older drivers, being aware of their age-related declines, adopt strategic compensatory changes in their driving patterns such as driving shorter distances. However, these changes often result in older drivers driving more often on high-risk urban streets and less often on lower-risk freeways.

Phase II: Video production (Apr-Jun 2013)

The video to be used for the experiment is produced in this phase. A video recorder is positioned under the rear-view mirror in a car to provide a video perspective similar to the view as seen by the driver. Various traffic incidents are planned and staged for filming in NTU campus. A team of student assistants helped in the video production process to coordinate the activities, handle the logistics, and ensure safety during the shoots. A continuous 20-minute driving video containing several incidents is produced. Response data for eight of the incidents (see Figure 1) are used for analysis.

Figure 1: Target incidents in the experiment

Phase III: Data collection and analyses (Jul-Oct 2013)

A total of 64 driver subjects of varying ages participated in the experiment. They were briefed about the background of the project and the instructions for the experiment. Upon attaining the subject's consent for participation, the subject is outfitted with a mobile eye-tracker which, after calibration, records where the subject is looking at (Figure 2a). The subject is then seated on a driving set-up (Figure 2b) and asked to view the experiment video as if he/she is driving. In the video, various incidents will take place and the subject will need to apply the brake as soon as possible in order to avoid a collision. The brake pedal will then trigger small LED bulbs attached to the side of the display screen as visual indicators.

(a)

(b)

Figure 2: (a) Eye-tracker; and (b) driving set-up

After the end of the experiment, the subjects are asked to complete a short survey questionnaire. The questionnaire asked for their opinions on the acceptable minimum and maximum age for driving, the safest driver age group, and their reasons for choosing so.

The research protocol is approved by the NTU Institutional Review Board.

4. Results of Research:

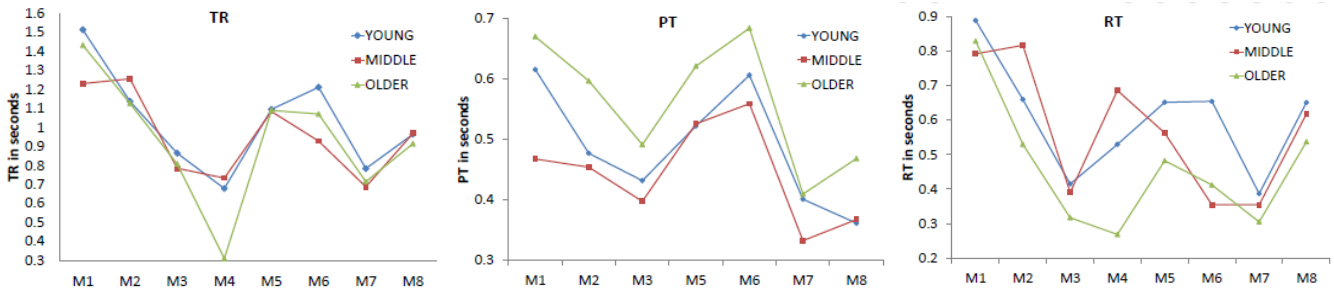
4.1: Total response time, perception time, and reaction time

The total response time (TR), perception time (PT), and reaction time (RT) for each incident and subject is determined and analysed. Across all incidents, it is generally observed that TR and RT do not differ significantly among the different subject groups. Younger drivers do not appear to perform poorly as compared to the middle-group drivers. Differences in PT between older and middle-group drivers are more pronounced.

Older drivers are found to have significantly longer PT for hazards that appear abruptly from the visual periphery. This implies that older drivers are inefficient in hazard detection, which is a critical first step in the information processing sequence.

On the other hand, older drivers have higher response rates in most of the incidents, implying more efficient mental models, which are usually developed over time with experience. The more efficient decision making of older drivers somewhat compensates for their longer PT, as reflected in the similar total response times. This means that accident risks for older and younger drivers vary according to the type of incident – whether quick detection or quick decision is more critical.

The average time measures are shown in Figure 3.



(a) (b) (c)

Figure 3: (a) Average TR; (b) average PT; and (c) average RT

4.2: Post-experiment survey

Subject opined that the safest drivers are those between 30 to 50 years of age, which is consistent with the literature although subjects had no prior access to the information. The average reported minimum and maximum ages for driving are found to be 20.0 and 65.4 years, respectively. Factors affecting subjects' choice of minimum age include driver maturity and judgement skills, while factors for considering maximum age include reaction time, physical health, eyesight, vigilance, cognitive capacity, and activity level. Self-bias is also observed in the subject responses where older drivers reported higher ages.

5. Future Areas to Take Note of, and Going Forward:

There are several limitations of this study. First, the effects of age on PT may be underestimated in this study, since the horizontal visual angle is limited by the video display. In reality the traffic scene is much wider and requires detection of hazards further in the visual periphery. Second, subjects did not need to handle vehicle control in the experiment and hence had more available cognitive resources. Nonetheless, as real-road driving experiments of such nature impose unnecessary risks on subjects, laboratory-based studies are still the most ideal research approach.

Going forward, the effect of size and colour of road hazards can be investigated. Future research may also consider further disaggregating RT into decision-making and movement time.

6. Means of Official Announcement of Research Results:

Yeung, J.S. and Wong, Y. D. Effects of age and experience on driver perception and reaction time, *Accident Analysis and Prevention* (submitted in Nov 2013)

Yeung, J.S. and Wong, Y. D. Ageing population and road safety – A driver's perspective, oral presentation, MSIWF Research Grant Ceremony 2013, 16 January 2014.