

Elderly Driver Features and Their Effects on Accident Risk

WANG Yin Hai, Student Member, the University of Tokyo
Takahashi Kiyoshi, Regular Member, the University of Tokyo
Kato Hironori, Regular Member, the University of Tokyo

Introduction

In Japan, although many measures have been tried to improve traffic safety, traffic accidents have kept on an increasing trend since 1990. From figure 1^[1] we can see that while fatalities fluctuating around 10 thousands a year, casualties keep on increasing. In 1995, the casualty amount of traffic accidents is 55.5% higher than that in 1977. Moreover, the record of fatal accident amount, 720,880 in 1969, was reset by 761,789 in 1995. This situation has been raising the concerns of both the government and the public: what caused the strong increase of accidents?

It is clear that traffic accidents are normally a comprehensive result of the factors belonging to three related categories, i.e. human, vehicle and road environment categories. Any change of the above three categories will cause the variation of accident occurrence. Of the three categories, it is not difficult to imagine that human category is the most important factor group for accident occurrence. Many studies are supporting our envision by showing that the effect of human factor is as high as 90% of the total^[2]. Therefore, we can definitely say that Japan's aging phenomenon has been inevitably affecting traffic safety in Japan.

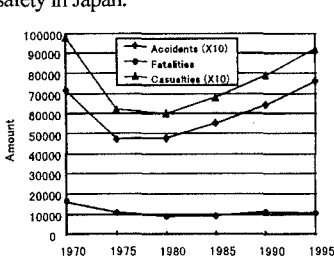


Figure 1: Trend of Accidents, Fatalities and Casualties in Japan.

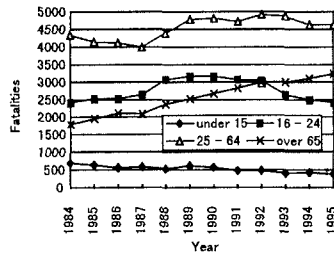


Figure 2: Transition of traffic fatalities in Japan

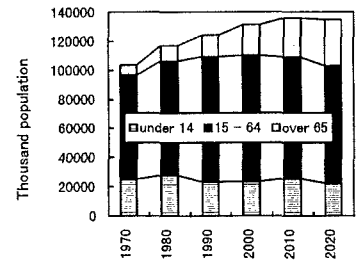


Figure 3: Population trend in Japan

Evidences can be found by looking at the breakdown structure of traffic fatalities of different age groups in figure 2. If we define elderly people here as those who are over 65 years old, we can see that although total fatality number is fairly stable around 10 thousand a year, the ratio of elderly fatalities keeps on increasing while fatality ratios of other age groups fluctuating or decreasing. This phenomenon can be explained by the transition of population structure as shown in figure 3^[3]. From 1950 to 1995, the ratio of elderly people in the total population had increased by 2.8 times, from 5% to 14%. In the coming future, the ratio will be further extended to about 24% in 2020. Correspondingly, the proportion of elderly drivers will increase to 20% of the total in 2040^[4]. Thus to study the features of elderly drivers and their involvement in traffic accident is very significant at present.

Declination of Mental and Physical Abilities with Aging

It is well known that human's abilities of both mental and physical declines with aging. Ishibashi^[5] analyzed the changing of human abilities with age and pointed out that the declination of mental and athletic capacities is remarkable for elderly people (please see figure 4). In detail, the following three capacity decreases are considered to affect accident risk directly.

- (1) Sight capacity. As shown in figure 5, sight ability is decreasing hastily with the increasing of age after 45. The capacity of discerning moving objects, which is very important for driving, decreases faster than that of static objects, and only about 50% of the capacity is left when a person entering elderly age. Besides, some study^[6] indicated that human's vision field also decreases with aging. Furthermore, an elderly driver generally takes a longer time to adapt the change of luminance.
- (2) Hearing capacity. Many studies relating elderly driver emphasized the effect of hearing ability on accident risk. Elderly people are especially poor in hearing voice of high pitch^[7] as shown in figure 6^[7]. Unfortunately, the sound of engine and horn is just located in the less sensible range of elderly drivers. This makes the elderly driver difficult to perceive the driving speed by engine voice and the approaching of other vehicles. In an experiment^[7], a testing young driver can detect the coming vehicle 25 meters away by engine voice while elderly driver only 12 meters away.

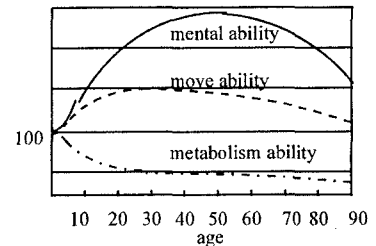


Figure 4: Mental and physical abilities as a function of age

- (3) Reaction capacity. De Silva^[8], studied the relationship between brake reaction time and age by experiment, and the result is shown in figure 7. Other study^[9] also found that elderly drivers have higher error rate in reaction. Needless to say, all the above changes of mental and physical capacities will increase elderly drivers' accident risk.

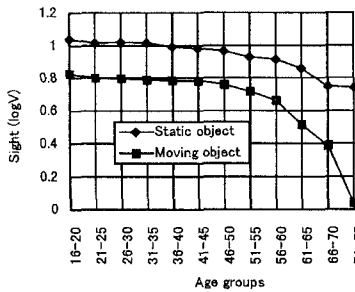


Figure 5: Sight ability of different aged persons

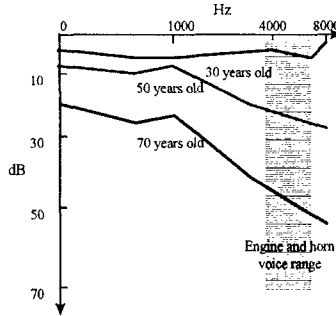


Figure 6: Hearing Ability Declination with Aging

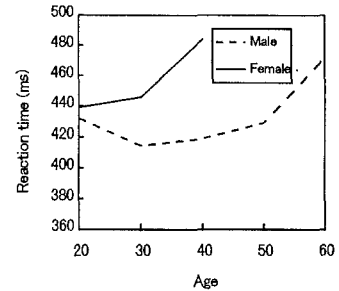


Figure 7: Brake reaction time as a function of age

Accident Risk of Elderly Drivers

Driving is a comprehensive procedure of perceiving environment information, deciding corresponding maneuver, and implementing it. Although elderly drivers normally have abundant driving experiences, the mental and physical ability declination due to aging makes them very poor in perceiving environment information and implementing their maneuvers. In other words, they are likely to perceive dangers later, react slower and less exact. Thus elderly drivers are easily to be involved in accidents (please see figure 8), especially under complex traffic conditions, such as intersections^[7].

Stamatidis et al.^[10] studied accident risk of elderly drivers at intersections in Michigan from 1983 to 1985 and found that, elderly drivers experienced the highest percentage among all driver age groups for accidents that involved a left-turn (same as right turn in Japan) movement. In Japan, Matsushima^[11] resulted similar conclusions: elderly drivers are easily the participants of right angle and right turning accidents (including head on accidents in right turning movement). Due to the poor physical condition, elderly people's tolerance for crashes are normally poor. Once they are involved into any accidents, the severity is normally higher than road users of other age groups. Goro^[12] found that death rate of elderly drivers is 2 or 3 times higher than 25 to 64 year old drivers.

Of all the traffic accidents in Japan, about 58.7% of total accidents and 44.7% of fatal accidents occurred in or near intersections in 1995. This means that accidents occurred at intersection areas are more serious than those of road segments. The concentration of elderly driver accidents and pedestrian accidents might be the main causation for that.

Conclusion

Japan is stepping rapidly into an aging society. Due to the declination of both mental and physical abilities of elderly drivers, they are easily to be involved in various kinds of accidents, especially under complex situations. The increasing population of elderly people is an important reason for the increasing trend of traffic accidents. Therefore, in order to improve traffic safety condition in the near future, studies on elderly driver behaviors must be strengthened.

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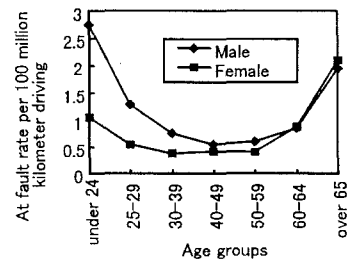


Figure 8: At fault driver rate in fatal accidents