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The perception of pedestrians from the perspective of elderly experienced and experienced drivers

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ABSTRACT

We examined hazard perception (HP) abilities among elderly experienced and experienced drivers, with regard to the presence of pedestrians in residential areas. Two evaluation methods were used: (a) observation of traffic scene videos and pressing a button when a hazardous situation was identified, and (b) driving in a driving simulator. The results of the video observation method showed that elderly drivers had a longer response time for hazard detection. In addition, four of the eight pedestrian-related events were difficult for elderly drivers to perceive when compared to experienced drivers. Elderly drivers, shown to have limited useful field of view, may also be limited in their ability to detect hazards, particularly when located away from the center of the screen. Results from the simulator drive showed that elderly drivers drove about 20% slower than experienced drivers, possibly being aware of their deficiencies in detecting hazards and slower responses. Authorities should be aware of these limitations and increase elderly drivers' awareness to pedestrians by posting traffic signs or dedicated lane marks that inform them of potential upcoming hazards.

1. Introduction

The elderly population (typically defined as 65 and older) is the fastest growing age group in the population of the Western world (Shinar, 2007; Oxley et al., 2006; Raitanen et al., 2003; OECD, 2001; Hakamies-Blomqvist and Henriksson, 1999). The increase in life expectancy and in quality of life dictates that more drivers on the road are elderly (Hakamies-Blomqvist et al., 2004). Nevertheless, the portion of elderly drivers involved in traffic injuries is not substantial relative to other age groups (e.g., novice young drivers). Shinar (2007) suggested that this portion is underestimated and that it is necessary to include exposure elements when looking at elderly drivers due to their relatively small portion within the general driver population and the fact that many of them hold a driving license but do not use it very often.

Unfortunately, aging is often accompanied by impairments in various driving-related functions, including vision, cognition and motor capabilities. Elderly drivers also have a narrower UFV (useful field of view) (Shinar, 2007). Yet, statistical evidence suggests that they do not impose a significant risk to others (e.g., NHTSA, 2003, p. 2). Hakamies-Blomqvist et al. (2005), for example, showed that the increase in older drivers' crashes involvement is smaller than the increase in older drivers' presence in traffic. Langford et al. (2006) showed that independent of age the amount of crashes per kilometers decreases as travel distance increases and that generally the elderly drivers have fewer crashes per kilometer driven than other age groups when travelling-distance is used as the exposure measure.

Lastly, the characteristics of the elderly driver population are difficult to determine since the variance in performance in most functions of individuals over the age of 65 is very large (Midwinter, 2005). Hakamies-Blomqvist and Henriksson (1999), for example, compared between two different age groups above the age of 65, and found that the elderly population is not homogeneous and that there were significant differences between the groups. Most of the differences were found between those under the age of 80 years old, and those above it.

Statistical data obtained from the Israeli Central Bureau of Statistics (2009) revealed that over the past 9 years the relative involvement of elderly drivers in pedestrian hits was higher than their relative involvement in crashes in general. Relative involvement is defined as the ratio between the percentages of drivers that are involved in crashes in a certain year, and their proportion within the entire population of licensed drivers of the same year. Fig. 1 shows the situation in 2008, yet the trends are similar since 1999. Elderly drivers have fewer crashes in general than any other age group of drivers. However, when looking at pedestrian hits, the claim is different; since 1999 their relative involvement in pedestrian hits has gradually increased (see Fig. 2).

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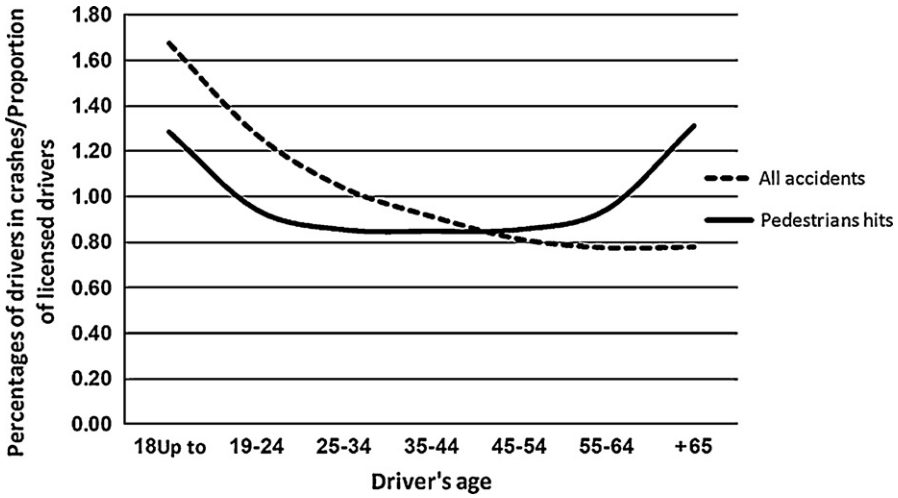

Fig. 1. The relative involvement of drivers in crashes in 2008, by age group (the data was obtained from the Israeli Central Bureau of Statistics, 2009).

The over-involvement of elderly drivers in pedestrian related hits raises questions about the way pedestrians are perceived by elderly drivers. This study, specifically, aimed to investigate whether elderly drivers' over involvement in pedestrian-related crashes stems from difficulties in perceiving the hazard, or due to coping with it once it is identified (i.e., motor deficits). Horswill and McKenna (2004) claimed that of the many skills a driver acquires, only hazard perception, i.e., the ability to 'read the road', correlates with traffic crash occurrence. Some studies have shown that unlike other driving-related skills, hazard perception does not diminish over the years, since it is based on accumulated experience and schemata (Quimby and Watts, 1981; Borowsky et al., 2010). Horswill et al. (2008) found that response time to hazards increases with age but that these age-related differences can be accounted for by measures of contrast sensitivity and UFV. Borowsky et al. (2010) used a video observation technique and showed that elderly drivers identified more hazards than experienced drivers, thereby; supporting the claim that hazard perception does not diminish over time. However, they also found that the identification of hazards by elderly experienced drivers came, in some cases, later than among experienced-experienced drivers. For example, when participants observed movies in which the vehicle approached an intersection, the elderly drivers responded much closer to the intersection than experienced drivers. Thus, the elderly drivers may be able to identify the hazard (e.g., the intersection) at the same time as the experienced driver, but have slower physical reaction time or, more likely, they project the hazards based on their own driving behavior which often consists of slower driving speeds than the obtained driving speed in the video-based scenarios. Since Borowsky et al. (2010) did not use a driving simulator this hypothesis could not be examined.

On the other hand, others found that hazard perception abilities diminish among elderly drivers (Lee et al., 2003; Bolstad, 2001). Bolstad (2001), for example, used a simulated drive with three levels of complexity. After each block of the simulated drive, participants were asked questions about the driving environment. The results confirmed that elderly drivers have a lower situation awareness (SA) compared to younger and middle-aged adults. Recently, Zhang et al. (2009) used a simulated drive to manipulate the presence of dynamic (moving traffic) and static hazards (construction area barriers) in rural and city drives. They too found that elderly drivers had a lower overall SA compared to young drivers under normal driving conditions. However, after interacting with a hazard, elderly drivers showed a degraded SA under city conditions and improved SA under rural conditions compared to young drivers. Furthermore, elderly drivers' performance worsened when dynamic hazards were involved. Thus, altogether, some studies found hazard perception related deficiencies among elderly drivers and others did not. These differences could be attributed to: (1) the measurement technique used (video-based versus simulated drive); (2) the road environment complexity (e.g., rural versus urban); (3) the type of hazards (e.g., dynamic or static); or to a com-

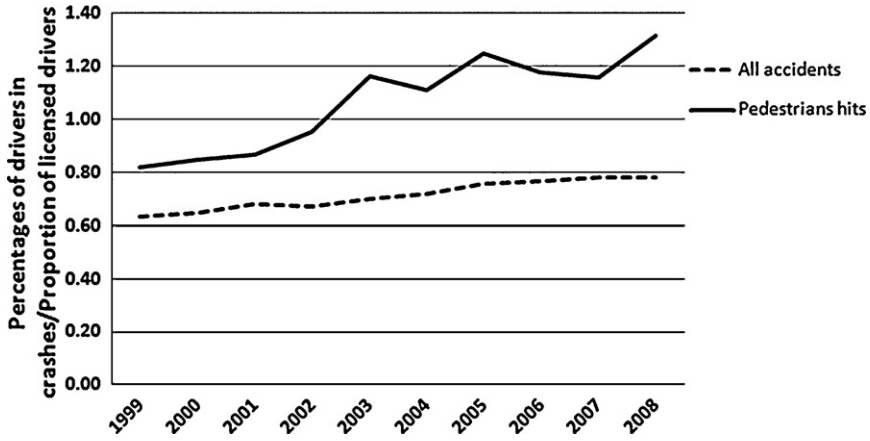

Fig. 2. The relative involvement of elderly drivers (age 65 and above) in crashes over the years 1999–2008 (the data was obtained from the Israeli Central Bureau of Statistics, 2009).