Title: THE ROLE OF COGNITIVE, PERCEPTUAL AND MOTOR ABILITIES IN ELDERLY PEDESTRIANS' STREET-CROSSING DECISIONS

Presenting Author: Viola Cavallo

Authors: V. Cavallo 1;A. Dommes 1;I. Aillerie 2;F. Vienne 2;

Affiliation
1. INRETS-LPC, Versailles, France, 2. INRETS/LCPC-LEPSIS, Paris, France

Abstract:
In spite of improvements in infrastructure design, road crossing remains a highly difficult task for elderly pedestrians. Psychological research has highlighted their difficulties in selecting safe gaps and adopting sufficient safety margins, especially in complex traffic situations. More specifically, we have observed previously that the speed of the approaching vehicles strongly affected the elderly peoples' crossing decisions: whereas younger pedestrians chose constant time gaps independently of speed, elderly people were found to accept shorter and shorter time gaps as speed increased, putting them at a higher risk at high speeds. The elderly pedestrians also missed many safe opportunities to cross in front of cars approaching at low speeds. We explained these behaviours by the neglect of speed information and the preferred use of simplifying heuristics based on vehicle distance. The objective of the present study was to better understand the underlying age-related changes that lead to these behaviours, with a special focus on perceptual abilities. 20 young (20-30 years), 20 younger-old (61-70 years) and 20 older-old (71-83 years) participants took part in the experiment. All participants carried out a street-crossing task in a virtual environment displaying an urban scene with traffic coming from one side. They had to cross the experimental road when they judged that crossing between the approaching cars was safe. The time gap between the cars varied between 1 and 7 s. Five vehicle speeds between 30 and 70 km/h were simulated. The participants also completed a battery of tests. Regarding cognitive abilities we assessed flexibility (Plus-Minus), inhibition (Stroop), speed of processing and selective attention (UFOV part 3). With regard to perceptual abilities, we used a time-to-arrival estimation task as well as a speed discrimination task. Mean walking speed was also measured for as an indicator of motor ability. In line with earlier findings, the participants' age significantly influenced the street-crossing decisions when vehicle speed was high (70 km/h) : whereas young pedestrians made almost no unsafe decisions, about a fourth of the decisions of younger-old and older-old pedestrians were unsafe. No age effect was observed concerning the rate of missed opportunities at low speeds (30 km/h). As regards cognitive abilities, the younger participants obtained significantly higher scores as elderly participants in flexibility, inhibition and UFOV tests. We also noted significant age-related effects in perceptual performance measures: younger participants discriminated speeds faster and gave more correct answers. Time-to-arrival estimates were less influenced by the speed of the approaching cars in younger than in elderly participants. Finally, younger pedestrians walked faster (1 m/s) than elderly pedestrians (0.9 m/s). Step by step ascending multiple regression analyses were used to examine for each age group the influence of cognitive, perceptual and motor abilities on street crossing behaviour. The two aspects of street-crossing behaviour to be predicted were unsafe decisions at 70 km/h and missed opportunities at 30 km/h. The predictors were the cognitive, perceptual and motor abilities mentioned above. The results of the hierarchical regression analysis showed various patterns for the three age groups suggesting that the behaviour-determining abilities differed according to age. In young pedestrians, none of the considered abilities predicted unsafe decisions at high speeds. 20 % of the variance of missed opportunities at low speeds was explained by the capacity of estimating time-to-arrival.
The younger-old pedestrians' unsafe decisions at high speeds were predicted (42 % of variance) by their ability of discriminating high speed and UFOV performance. Missed opportunities at low speeds were predicted (55 %) by low speed discrimination, flexibility and inhibition. In older-old pedestrians, only walking speed predicted unsafe decisions at high speeds (25 % of variance).

Low speed discrimination predicted missed opportunities at low speeds (43 % of variance). As a whole, these findings indicate that perceptual abilities play an important role in street-crossing behaviour. With regard to unsafe decisions, the decline in perceptual abilities was determinant in early aging, whereas declining motor abilities became more decisive when age was increasing further. Concerning missed opportunities, perceptual abilities accounted for a significant part of the variance in all age groups.

By pointing out the abilities that influence street-crossing behaviour, the present study provides insight into the source of age-related risky decisions and indicates ways for implementing effective countermeasures.