



## Crossing road intersections in old age—With or without risks? Perceptions of risk and crossing behaviours among the elderly



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### ARTICLE INFO

#### Article history:

Received 14 February 2017

Accepted 3 March 2018

#### Keywords:

Elderly pedestrians

Crossing behaviours

Risk perceptions

Environmental perceptions

Road safety

### ABSTRACT

Pedestrians aged over 65 are known to be a critical group in terms of road safety because they represent the age group with the highest number of fatalities or injured persons in road accidents. It is widely recognized that the latter is due to the physical vulnerability of this age group in case of injury. However, physical and cognitive decline come into play during the action of crossing a street. Various studies have attempted to connect the crossing behaviours of the elderly with variables such as age, gender, sensory acuity, level of attentiveness, physical decline and the design of intersections. In demonstrating the complexity of the relationship between people and their environments, the literature suggests that age, physical ability, and the spatial configuration of roads are major components of road safety. Moreover, people's knowledge and mastery of their environments, as well as their ability to adapt to change affects how they move through space. Taking these factors into account, this study examines the perceptions of elderly pedestrians with regards to the quality and risks of road crossings in the context of Montréal, Québec, in Canada. The analyze are based on observations and questionnaires in order to bring to light a better understanding of the relationship between the crossing behaviours, characteristics and perceptions of the elderly. While previous studies have examined perception and observation separately, this study is unique in having looked at both angles simultaneously. Five profiles of elderly people in both urban and suburban environments were established. A sample of 181 elderly pedestrians (65–93 years of age, AVG = 74) were surveyed using a questionnaire. In addition to close-ended questions, respondents were asked to evaluate 17 environmental ambiance and risk behaviours according to various scales. Using principal component analysis (PCA) and hierarchical cluster analysis (HCA), the data was grouped into 6 categories that define and distinguish 7 profiles of elderly people. These profiles were explored according to the socioeconomic status and crossing behaviours of respondents. The probabilities of adopting different crossing behaviours were tested by employing logistic regression models. The results reveal greater variability in the perceptions of the elderly in terms of risk related to crossing behaviours and type of signalisation at intersections. Even among seniors, the perceptions of risk varied greatly, which may have had an impact on their behaviours. While some of the behaviours observed coincided with the perceptions of respondents, the results of this study suggest that they only play a marginal role.

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## 1. Background

### 1.1. Aging population, daily mobility and crash involvement

The reality of an aging population, particularly in “economically developed” countries, has made the everyday mobility of seniors an issue of growing interest. In a context where an increasing number of people globally are dependent on cars, efforts to encourage walking—both utilitarian and leisurely—has become a public health priority (Kohl et al., 2012). However, public transportation and walking environments are not always well-adapted to accommodate the elderly. In order for walking to become an attractive, efficient, and safe mode of transportation for the elderly, the way public spaces are designed must be rethought/reconsidered in order to accommodate to their needs and preferences. In addition to improving the health and autonomy of seniors, quality walking environments/pedestrian spaces provide benefits to other social groups such as children.

As a result of ill-adapted urban environments, the elderly have demonstrated a strong ability to/great adaptability in their spatial use according to different modes of transportation (Lord, Després, & Ramadier, 2011). Depending on both the real road risks and the perceived quality of urban spaces, elderly pedestrians adapt in order to get around in a space that they consider appropriate to their capabilities. Older pedestrians modify their walking behaviours, by limiting the distances they travel, choosing certain paths over others, or employing other coping tactics (Huguenin-Richard, Granié, Coquelet, Dommès, & Cloutier, 2014; Lord, 2012; Negron-Poblete, Séguin, & Apparicio, 2012). At the same time, these actions can increase their exposure to risk.

The elders are more highly represented than other sociodemographic groups in pedestrian crashes. According to the National Highway Traffic Safety Administration, almost 20% of pedestrians killed in road crashes in the United States in 2012 were over 65 years of age, despite the fact that this group constituted only 13% of the total population (NHTSA, 2012). Similarly, 40% of pedestrians in fatal accidents in France in 2012 were over 75 years of age (Observatoire National Interministériel de la Sécurité Routière, 2013) although they represented only 9% of the population (Institut national de la statistique et des études économiques, 2012). Furthermore, it is reported that up to 50% of all injured pedestrians in OECD countries are seniors (Forum International des Transports, 2012). Not only are they overrepresented in such cases, they also tend to suffer more severe injuries (Abou-Raya & Elmeguid, 2009; Martin, Hand, Trace, & O'Neill, 2010; Nicaj, Wilt, & Henning, 2006) and have longer stays in hospitals (Loo & Tsui, 2009).

### 1.2. Determinants of safe crossing for older adult pedestrians

Research on the risk of elderly pedestrians being involved in a car crash has resulted in a better understanding of the principal causes of their heightened vulnerability. From a psycho-cognitive standpoint, this can be explained by the overconfidence of the elderly in their ability to cross the road in the time allotted. This is affected by not only their walking speed and strength, but also their cognitive and physical impairments such as hearing and vision. When choosing a safe clearing in the road to cross between cars, pedestrians have to consider their ability to cross the intersection in the available time before the arrival of the next vehicle (Lobjois & Cavallo, 2007; Oxley, Ihsen, Fildes, Charlton, & Day, 2005). This can be problematic for the elderly given their physical and cognitive impairments that can affect their ability to effectively evaluate situations. For instance, they may overestimate/misperceive their walking speed, which tends to slow with age (Lassarre, Papadimitriou, Yannis, & Golias, 2007), or there may be a greater lapse of time between the moment they mentally decide to cross and the moment they physically begin to (Dunbar, Holland, & Maylor, 2004; Gates, Noyce, Bill, & Van Ee, 2006; Holland & Hill, 2010; Montufar, Arango, Porter, & Nakagawa, 2007; Oxley et al., 2005). In the case of signalized crossings, the design speed is often higher than seniors' walking speed capacity and the green light phase does not suffice. Similarly, the challenges associated with crossing the street increase as the environment becomes more complex, as with two-way streets or multi-lane roads (Dommès, Cavallo, Dubuisson, Tournier, & Vienne, 2014). One explanation is that seniors may fail to pay attention to spatially complex information, concentrating instead on their immediate surroundings (Oxley, Fildes, Ihsen, Charlton, & Day, 1997). However, one study suggests that adults who are able to more accurately judge their capabilities tend to allow themselves more time to cross than younger pedestrians (Lobjois & Cavallo, 2007, 2009). In any case, due to a decline in physiological functions such as hearing and vision, the elders have a harder time assessing the risks at hand. Many struggle to discern the speed at which cars are approaching. Therefore, distance alone is often the sole factor considered in gaging whether or not it is safe to cross (Lobjois & Cavallo, 2007; Oxley et al., 2005).

### 1.3. Crash risk of older adult pedestrians and road environment perceptions

The perceptions of the hazards and ambiance at crossing points is another common point of interest for researchers when analyzing and predicting pedestrian behaviours. This is typically determined by observing individuals' head movements and gaze (see Avineri, Shinar, & Susilo, 2012 or Holland & Hill, 2010) which hint at the location of the hazards which they are most concerned with. For example, a fear of falling can be deduced from a head movement directed toward the ground while crossing. What has been termed “delegating” can be witnessed at signalized intersections when pedestrians spend more

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