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Gender differences in factors predicting unsafe crossing decisions in adult pedestrians across the lifespan: A simulation study

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ABSTRACT

Adult pedestrian accident data has demonstrated that the risk of being killed or seriously injured varies with age and gender. A range of factors affecting road crossing choices of 218 adults aged 17–90+ were examined in a simulation study using filmed real traffic. With increasing age, women were shown to make more unsafe crossing decisions, to leave small safety margins and to become poorer at estimating their walking speed. However, the age effects on all of these were ameliorated by driving experience. Men differed from women in that age was not a major factor in predicting unsafe crossing decisions. Rather, reduced mobility was the key factor, leading them to make more unsafe crossings and delay longer in leaving the kerb. For men, driving experience did not predict unsafe road crossing decisions. Although male drivers were more likely to look both ways before crossing than male non-drivers, the impact of being a driver had a negative effect in terms of smaller safety margins and delay in leaving the kerb. The implications of the different predictor variables for men and women for unsafe road crossing are discussed and possible reasons for the differences explored.

1. Introduction

Examination of published statistics shows that within the adult population the risk of being involved in a pedestrian accident varies not just with age, but also with gender (Department for Transport, DfT, 2008). Although men of all ages are at greater risk of serious injury than their female counterparts, the age pattern of risk differs between the genders. For men, young adulthood is the age of highest risk, whereas for women it is the over 75s (see Holland and Hill, 2007, for an analysis). These differences within the adult population need explanation and could lead to more focussed road safety interventions. In previous studies, significant differences were found between different adult age groups, men/women, and drivers/non-drivers in the importance of attitudes, beliefs and personality variables as predictors of intention to cross the road and simulated crossing behaviour in less than ideal locations (Holland and Hill, 2007; Holland et al., 2009), specifically highlighting an effect of age for women non-drivers. The aim of this study was to examine whether these different demographic groups also differ in terms of predictors of road crossing accuracy.

One possible factor behind age and gender differences in accident statistics is driver status. Differential driving skill may contribute to pedestrian risk differences between older and younger women, with women over the age of 70 being less likely to be drivers than older men or younger women (DfT, 2008). Early work suggested that pedestrians without a driving license were 3–4 times more likely to be involved in a road accident, accounting for differences in pedestrian mileage (Biehl et al., 1970, cited by Carthy et al., 1995), suggesting that driving experience and skill may protect against effects of age in the pedestrian scenario. Driver experience has been shown to influence a number of skills that may also affect traffic judgments as a pedestrian, such as visual search (Underwood et al., 2002), and judging vehicle arrival times (Carthy et al.). Thus the central aim of this study was to determine whether driver experience/status ameliorates any negative effects of age on pedestrian skills, and whether this accounts for gender differences.

A basic skill to examine is whether people look left and right before crossing. Previous studies have found an older age advantage in looking behaviour (e.g. Wilson and Grayson, 1980), or very little age or gender differences, but studies found all involved signal controlled crossings (see Dunbar et al., for a review). This study examined looking behaviour in relation to safety of gaps chosen in a standard two-way road situation.

A second skill is that of choosing a safe gap in which to cross. Using a simulation task, Oxley et al. (2005) found that their oldest group (75+ years) made the least safe decisions, with those in their 60s being no different from the youngest group (30–45 years). Evidence consistently suggests that older people are more likely

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to accept gaps that are short relative to their walking speed or the speed of traffic (Oxley et al., 1997, 2005; Lobjois and Cavallo, 2007). However, both Oxley et al. (2005) and Lobjois and Cavallo used decision delay as a component of the time used to calculate whether or not a safe gap was selected, and neither actually required participants to begin to move. In addition to decision delay, in a real road crossing situation there is also a "start-up" delay, i.e. the time it takes a person to begin to move once they have made the decision to do so, which is specifically slowed in older adults. Wilson and Grayson (1980) demonstrated that people aged 80 years plus took 39% longer total crossing time than pedestrians aged in their 20s, but their walking time kerb to kerb was only 19% longer. Not only are the oldest people spending more time in the road, increasing their exposure to traffic, but having made the decision to cross, they are also slow to leave the kerb, thus not making the most of the available time. Keall (1995) further indicates that the clear increase in risk per road crossed for people in their 70s and beyond may well be a function of this greater exposure in the road itself, although he comments that if figures were adjusted for this slower walking time, there would still be an upward trend. To allow for this, the present study requested participants to stand to watch videoed traffic and included time from the beginning of a chosen gap in traffic to actually beginning to move, as the start-up time, thus measuring both safety of gaps chosen and start-up delay.

Dramatic differences between the levels of unsafe crossing choices in older participants found in the above studies (70% for over 75s in Oxley et al., 5.9% for 70–80-year olds in Lobjois and Cavallo) may be the result of participant differences, in that Lobjois and Cavallo screened for mobility measures and cardiac, neurological and visual disorders resulting in their oldest group having a faster walking speed than Oxley et al.'s. These differences suggest that walking speed/mobility may be having a significant effect on safety of gap choices. In this study, we assessed safety of gap chosen and safety margin left using individual walking times, and also assessed the contribution of mobility measures to safety of crossing decisions.

Research reliably demonstrates that walking speed decreases with increasing age, even when specific mobility impairments are factored out (Dunbar et al., 2004). However, women show a reduction in gait speed from about 40 years of age, much earlier than that for men (Kwon et al., 2001). Nevertheless, older people do adjust their walking speed sensibly to take account of traffic conditions (Knoblauch et al., 1996). The question of whether slower walking speed and corresponding increased exposure to traffic is actually related to increased risk of traffic accidents has not been answered in the literature, although there are indications that there is a relationship. For example, there are reports that older adults are more likely than younger adults or children to be involved in a pedestrian accident in the far lane of a two-way road (Fontaine and Gourlet, 1997; Grayson, 1980). Although not all studies have replicated this finding, this could be due to an interaction between age and gender with far side accidents increasing with age more for women than men (e.g. see analysis of Carthy et al.'s, 1995 figures in Dunbar et al., 2004).

An important component of the crossing task not examined by previous research is awareness of one's own crossing speed. Older people do adapt walking speed and choice of gap to the traffic conditions in a similar manner to the way younger pedestrians do, but the very oldest pedestrians are frequently selecting gaps that are too short for them (Oxley et al., 2005; Lobjois and Cavallo, 2007). In order to determine the extent to which awareness of walking speed is a causal factor in making erroneous road crossing choices, individual estimations of walking time were compared with actual walking times over the same distances.

In summary, the aim of this study was to identify which factors affect road crossing decisions and the differential effects of these within different demographic groups. Using a simulation study with filmed real traffic, we examined effects of age, gender, driving experience and mobility on a range of measures in a controlled environment. The specific hypotheses were:

(1) Published accident data differences between age and gender groups within the adult age range may be related to driver status. Non-drivers may be crossing the roads differently to drivers.
(2) The road crossing skill components: looking behaviour, start-up delay, safety margins and estimation of one's own speed of movement accuracy, will vary with age but will also independently predict safety of choices.
(3) Driver experience may ameliorate some of the changes seen with increasing age in selection of safe gaps to cross and in individual skill components.
(4) Mobility impairment, including, but not exclusive to, walking speeds will contribute to safety of choices, independently of age.

2. Method

2.1. Participants

The 218 participants were an opportunity sample recruited via advertisements in and around Aston University, and included students, staff and members of the public attending functions/clinics at the University (see Table 1 for breakdown by age, gender and driver status). Participants were screened for visual field defects by self-report, the majority of older participants having had recent thorough eye examinations at the university's optometry department. In order to achieve a sample that mirrored the range of abilities in the population, participants were not screened for mobility or ill health, the only requirement being that they commonly went out and crossed roads independently.

2.2. Mobility measures

Participants were asked whether they could walk a quarter of a mile, manage stairs easily and about any illness or injury which affected walking. Each answer indicating a difficulty was given a score of 1, such that a total of 3 indicated significant difficulty. They were also asked to perform a timed sit-to-stand (STS) test (stand up five times from a seated position without use of hands to push up). Any person having difficulty was timed during one sit-to-stand movement, or this task was omitted. STS performance is related to a range of sensorimotor, balance, and psychological factors in older adults (Lord et al., 2002). Walking time was measured by asking participants to walk 7 m at normal walking speed, with use of any walking aids if required. A mean of two measures was used.

2.3. Simulation task

Participants watched a 9-min video of a 7 m wide road with two-way traffic in a 30 mile an hour (48.28 km per hour) zone, in a city centre location. The road was filmed in three directions from the kerb side (left, centre and right) by separate cameras. The video was presented simultaneously on three angled screens positioned in front of the standing participant such that the participant had to turn their head to the left or right to watch the traffic, simulating an actual road crossing situation. This method of pedestrian simulation has been used previously (Whitebread and Neilson, 2000). Participants were instructed to indicate when they would cross the road by saying "now" and by taking a step forward. They then returned to the original position and looked for the next safe crossing gap. No indication of the number of safe crossing gaps was given