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Accident Analysis and Prevention 39 (2007) 224–237

ACCIDENT ANALYSIS & PREVENTION

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The effect of age, gender and driver status on pedestrians' intentions to cross the road in risky situations

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Received 14 December 2005; received in revised form 27 June 2006; accepted 7 July 2006

Abstract

The theory of planned behaviour (TPB) has been used successfully in the past to account for pedestrians' intentions to cross the road in risky situations. However, accident statistics show age and gender differences in the likelihood of adult pedestrian accidents. This study extends earlier work by examining the relative importance of the model components as predictors of intention to cross for four different adult age groups, men, women, drivers and nondrivers. The groups did not differ in the extent to which they differentiated between two situations of varying perceived risk. The model fit was good, but accounted for less of the variance in intention for the youngest group (17–24) than for other age groups. Differences between the age groups in intention to cross seemed to be due to differences in perceived value of crossing rather than differences in perceived risk. Women were less likely to intend to cross than men and perceived more risk, and there were important age, gender and driver status differences in the importance of the TPB variables as predictors of intention. A key implication of these findings is that road safety interventions need to be designed differently for different groups.

Keywords: Pedestrian; Age; Gender; Nondrivers; Theory of planned behaviour; Road safety education; Perceived risk

1. Introduction

Despite an excellent international record for road safety of drivers and passengers, the UK is ranked 8th in the pre-2004 EU for pedestrian safety (Department for Transport [DfT], 2004a), with pedestrians 19 times more at risk of being killed per distance travelled than drivers (Department of the Environment, Transport and the Regions [DETR], 1999). Within adults, the risk of being involved in a pedestrian accident varies with age and gender, with older adults at greatest risk of being seriously injured or killed per distance walked (DfT, 2004b) and men at all ages being at greater risk of serious injury than women (DfT, 2004a).

Giving the lowest risk group (those aged 25–59 for each gender group) a baseline index of 1, it can be illustrated that gender interacts with age, based on accident statistics (DfT, 2004a). For men, the 16–24 years group is at the most risk (risk index of 2.13), more than twice the risk of the 25–75 years group, after which the risk index rises again (to 1.73). For women, the over 75s are at the greatest risk (risk index of 3.23, with risk index for young women aged 17–25 being 2.35). The increase for women is greater and occurs earlier than that for men, with an increase of 21% between 25–59 years and 60–74 years (no corresponding increase for men).

The important question is what differences in pedestrian characteristics may be contributing to these differences in risk? The contributions of changes in cognitive and sensory skills with increasing age to pedestrian safety have been reviewed elsewhere (Dunbar et al., 2004), as have characteristics and attitudes of younger adult road users that may lead to them taking greater risks on the roads or failing to perceive hazards (e.g. Parker et al., 1992a). One key difference between the age groups and genders which may contribute to the risk differences is the extent to which people are drivers. More men than women drive at all ages (e.g. see DTLR, 2001a) and therefore may be expected to be pedestrians less and/or to have differing traffic perception skills. The most obvious explanation of increased accident risk for older women is that people who drive less, probably walk more, and are thus more exposed to risky situations as pedestrians. However, examination of figures given by the DTLR (2001a), in combination with accident data (DTLR, 2001b), suggests that

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doi:10.1016/j.aap.2006.07.003

although accident rate decreases with increase in percentage of licence holders for both genders, the relationship with distance walked is not straightforward. Women are less likely to have a driving licence at all ages, but walk more than men only during the middle adulthood years. As they get older and licences become less common, their level of walking reduces to below that of men of the same age. This suggests something other than the amount one walks that may make nondrivers at more risk as pedestrians than drivers. There is some evidence that skill differences between drivers and nondrivers may account for differences in accident rates (Carthy et al., 1995), though this study found no age or gender effects. However, the risk differences seen in adulthood may also be the result of differences in beliefs regarding crossing in less than ideal situations and behaviour in such situations. There is substantial evidence that differences in attitudes and beliefs towards risky driving behaviour (such as speeding) do indeed mirror age and gender differences in accident data (e.g., Conner et al., 2003; Parker et al., 1992b) and predict actual behaviour (e.g. Elliott et al., 2003a,b). This study therefore investigates pedestrian behaviour in order to examine differences in attitudes and beliefs predicting intention to cross in risky situations in relation to the demographic differences in accident data outlined. Further, differences in demographics, basic skill, cognitive or visual function in terms of relation with accident data, may not be as amenable to change or intervention as beliefs that have been shown to predict risky behaviour. Knowledge of any demographic differences in such beliefs is therefore vital for designing interventions.

One way of investigating such beliefs is through the use of a model such as Ajzen's (1991) theory of planned behaviour (TPB). In this model, intention is given a key role in the prediction of actual behaviour. Intention is presumed to reflect the motivation a person has to perform the behaviour, and their plans and expectations that they will perform it in the near future. Ajzen highlights the issue of control in the success of intention actually predicting behaviour in that people can only do what they intend if their behaviour is under their own volitional control (Ajzen, 1991). Thus accurate perception of control over performing a behaviour (perceived behavioural control, PBC) is also a key predictor of both behaviour and intention in the TPB model. This perception of the ease or difficulty of performing a behaviour may be expected to vary as a function of the situation as perceived by the person, e.g. in terms of difficulty or risk. PBC can account for situations where behaviour of choice may not be carried out due to lack of volitional control, an important factor in a study involving older people whose road crossing decisions may be affected by mobility constraints. The TPB also puts forward attitude towards the behaviour, and subjective norms, as predictors of intention. Attitude is concerned with a person's evaluation of the behaviour, e.g., would it produce a positive or negative outcome? Subjective norm is concerned with the perceived social pressure to perform the behaviour or not. The relative importance of these three direct predictors of intention is presumed to vary across situations and behaviours (Ajzen, 1991), but the general principles which guide the manner in which they vary have not been fully explored, particularly with reference to crossing at risky locations.

In the TPB, the direct measures of PBC, attitude and subjective norm are each underpinned by indirect measures. Underpinning PBC are beliefs about the extent to which a person believes that they are in control of their behaviour or risk in this particular situation, or the extent to which such behaviour is believed to affect the risk. More specific than general locus of control, PBC is the product of the control beliefs related to the behaviour, e.g., "factors that increase or reduce the perceived difficulty of performing the behaviour in question" (Ajzen, 1991, p. 196) and the perceived power of the control belief to actually control the outcome (perform the behaviour or not). Attitudes are presumed to be predicted by behavioural beliefs. Ajzen (1991) proposes that attitudes towards behaviours are formed by beliefs that people hold about them in terms of expectancy of the outcome of that behaviour, e.g., the cost of performing the behaviour. Thus people have positive or negative values of a behaviour which automatically form an attitude towards that behaviour. However, the subjective value of the perceived outcome also contributes to the attitude in direct proportion to the strength of the outcome belief. Thus, attitudes are predicted by the product of behavioural beliefs (belief about the outcome of the behaviour) and evaluation of that outcome, that is, the TPB is an "expectancy-value" model. Finally, subjective norms are presumed to be predicted by a person's normative beliefs about what significant other groups would expect them to do, combined multiplicatively with their motivation to comply with the opinions of others, i.e., the value component. Studies vary as to whether they adopt the direct measures to predict intention, or the indirect, combination measures, with the correlation between the two being variable and sometimes disappointing (Ajzen, 1991). However, in a road safety context, Elliott et al. (2005) showed that the combined measures predict the direct measures and intentions to a similar degree, and underline the added predictive power given by the multiplicative combination over and above the contribution made by each component separately. For this reason, and in line with previous studies of pedestrian behaviour (e.g. Evans and Norman, 1998, 2003), this study uses the indirect multiplicative measures of attitudes and subjective norm to predict intention.

A crucial issue for studies of safety related behaviour, where it is difficult to measure actual behaviour, is the relationship between intention, which we can measure, and actual behaviour, which we cannot safely measure. Meta-analyses have found the average amount of variance in actual behaviour predicted by intention in the TPB model to be 27% (Armitage and Conner, 2001), with an upper limit of 38% and a further 2–12% predicted when PBC is used as an additional direct predictor of behaviour, separate to its prediction of intention (Rivis and Sheeran, 2003). More specifically, studies of actual behaviour in traffic have found the TPB to be a useful model of prediction (e.g. Quine et al., 1998; Elliott et al., 2003a,b). For example, Elliott et al. (2003a) found that intention was a significant independent predictor of observed speeding behaviour in a validated driving simulator. Moreover, Holland and Conner (1996) found that changes in intention to speed taken from randomly selected drivers along a road that was the subject of a police anti-speeding campaign mirrored the actual changes in speeding measured along the road. Thus it is proposed that using such models

and intention as at least a partial proxy for actual behaviour is scientifically appropriate and useful in situations where experimentally assessing actual behaviour may present risk to the participant and serious ethical concerns.

Two significant studies that have used TPB to analyse adults' road crossing decisions are those by Evans and Norman (1998) and Diaz (2002), with further evidence from Evans and Norman (2003) on adolescents' road crossing decisions. Evans and Norman (1998) found that subjective norm, PBC and attitudes accounted for 39–52% of the variance in intention to cross the roads in three risky situations, with PBC emerging as the most important predictor variable. Although Evans and Norman (1998) did not examine any of the above variables separately for different age groups, they did examine age as a predictor variable for intention to cross, and found that older people were generally less likely to say that they would cross the roads in the situations presented. No gender differences were found, although driving studies have generally found that men, especially young men, display more risk-taking behaviour and attitudes than women (e.g., Parker et al., 1995; Laapotti et al., 2001).

Diaz (2002) contrasted two adult age groups, under and over 26 years, using a questionnaire examining prediction of intention to perform illegal mid-block crossing. As with Evans and Norman (1998), no effects of gender were found, and younger people were significantly more likely to intend to cross in the situation given. Diaz (2002) also found that younger people had a more positive attitude towards crossing in such risky situations than the older group, perceived more acceptance from significant others, and had a lower PBC. However, the amount of variance in intention that the TPB variables account for together is not given in this study, and although the results report a significant relation between intention and actual behaviour, the measurement of actual behaviour is not reported.

The aim of this study is to extend the above work by examining effects of age, gender and driver status, as they relate to the components of the model, examining both differences in beliefs between demographic groups, and differences between groups in the contribution of each belief to the variance in intention to cross in less than ideal circumstances.

Previous studies addressing crossing intentions have not compared the TPB model fits for different age, gender and driver status groups. However, group differences have been found in related areas. For instance, Conner et al. (2003) found that normative beliefs were stronger predictors of intention to speed for men than for women. Moreover, Parker et al. (1992b) found differences between age groups in outcome evaluations with regard to driving violations, behavioural, normative and control beliefs in a study comparing attitudes of high and low risk young male drivers. They also found that subjective norm was a stronger predictor of intention than attitudes. Quine et al. (1998) found that subjective norm and PBC were particularly influential in younger adults; PBC also emerged as the most important predictor of road crossing intentions in the adolescents studied by Evans and Norman (2003), again underlining the central role of control. Conner et al. (2003) found that normative beliefs were particularly influential for men. While previous road safety research examining TPB variables specifically with older adults was not found, there is research in health education fields such as exercise (Conn et al., 2003) and breast cancer screening (Grunfeld et al., 2003) which found that beliefs about outcome were particularly influential for older women, again supporting the hypothesis that components of the TPB may be differentially important for different demographic groups.

These group differences are in line with Ajzen's (1991) suggestion that the relative importance of the TPB variables in the prediction of intention would be expected to vary across situations, behaviours (and populations). Demographic differences are investigated here by examining interactions between age, gender and driver status for the different TPB variables. Age and gender differences are well documented in various risk-taking areas (e.g. DeJoy, 1992) and in actual road crossing behaviour specifically (Hamed, 2001), with the latter study finding that women, older pedestrians and drivers took fewer risks.

The fact that the TPB does not fully predict intention implies that the TPB is open to the incorporation of further variables, particularly if, as Ajzen (1991) points out, it can be shown that they predict a significant proportion of the variance in intention or behaviour further to that predicted by the TPB variables (see also Conner and Armitage, 1998). With regard to road crossing decisions, moral norms and the anticipated emotion of taking the risk have been included, with the latter being shown to contribute a significant proportion of variance to the prediction of intention in a pedestrian study with adolescents, beyond the impact of the TPB components (Evans and Norman, 2003). This concept can be defined as the "enjoyment" factor of risk taking (or the positive implications of avoiding frustration that waiting longer or walking further may imply) and can be seen as an important determinant of intention in this situation. Anticipated affective reaction has been shown to be a significant predictor of intention (behavioural expectancy) after taking into account attitudes, subjective norms and PBC in a variety of risk related areas (Richard et al., 1996), and, specifically, in other road safety contexts, e.g., intentions to commit motorway violations (Parker et al., 1995). While it may be argued that emotion towards the behaviour is an attitude, these specific road safety studies support its inclusion as a separate predictor. Indeed, Ajzen (1991) advocates distinguishing between evaluative and affective outcomes and refers to two studies that provided strong evidence for the discriminant validity of separate evaluative and affective predictors (Ajzen and Driver, 1991; Breckler and Wiggins, 1989). Importantly, in an intervention aimed at changing intention to break speed limits, Parker et al. (1996) found that increasing the salience of anticipated affect was more effective than interventions directed at influencing the basic TPB components. The implication is that affect does need to be considered separately from evaluative attitudes, as a direct predictor of intention. However, one can distinguish between anticipated affect (factors such as regret after the behaviour) and affective attitudes (emotions towards the behaviour) and it is the latter which are examined here (see Parker et al., 1998). The examination here of interactions between demographic groups will help determine whether the role of affect is specific to particular age, gender or driver status groups.

A further variable of potential importance here is that of perceived risk. Although it is known that differences in perceived risk exist between younger and older male drivers (Deery, 1999), no studies to date have looked at such differences among pedestrians and the subsequent impact on intention to cross. Previous work with drivers in a related area (but including pedestrian situations) has shown that the amount of self-bias in perceived accident likelihood reduced with increasing age, i.e., older drivers were less likely to perceive themselves to be less at risk than their peers (generally, people perceive themselves to be less at risk than their peers), but self-bias increased with greater driving experience and with greater perceived control (Holland, 1993). In a general review of risk perception, Van der Plight (1996) concluded that although perceived risk is an important determinant of preventive behaviour, this relationship is dependent on the measure of perceived risk being conditional (upon performing the behaviour) rather than more general, and that in some circumstances its effect is mediated by subjective norms and attitudes. Given the evidence above, this study will incorporate measures of affective attitudes and risk perception in addition to the traditional TPB variables and also examine the differences between situations of varying perceived risk. In particular, interactions between age and gender are of interest to determine if younger men do indeed perceive less risk or intend to cross more than other groups, and possible sources of such differences will be examined in terms of the beliefs that predict intention. Interactions of the demographic variables with level of risk of situation are also crucial to determine whether the groups differ in their response to differing situations. Such interactions will also enable us to examine older at risk groups, for example, older women and nondrivers.

A key aim of the study is to examine whether the impact of the components of this extended TPB model varies between groups or situations per se, but also as a function of their contribution to the prediction of behavioural intention. The purpose is to inform both our efforts to understand demographic differences in accident risk, and also education and future interventions. For example, road safety campaigns rarely focus on adult pedestrians, but those few that are aimed at older pedestrians tend to focus on passive changes, such as wearing brighter colours, or having up-to-date spectacle prescriptions, as opposed to the decisions people make about where to cross (see Dunbar et al., 2004, for a review).

In summary, in an attempt to explain the demographic differences in pedestrian accident statistics and thereby inform road safety education, this study uses the TPB to identify group differences in intention to cross roads in two situations of varying perceived risk. Specifically, it aims to investigate whether:

1. Older people, women and drivers are less likely to intend to cross than other groups, particularly in the more risky of the situations depicted.
2. Different age, gender and driving status groups differ in their perception of risk in two road crossing situations and whether such differences will affect their intention to cross, in addition to the effect of TPB components.
3. There are age, gender, driving status and risk level (situational) differences in the TPB predictor variables and affective attitudes that provide indications of the source of pedestrians' intention formation process.
4. There are group differences in the relative importance of TPB variables and additional variable of affective attitudes that predict intention to cross.

2. Method

2.1. Participants

The 293 participants ranged in age from 17 to 92 years. They were divided into four age groups based on differences in accident statistics in the general population, gender and driver status as shown in Table 1. The middle-aged and older adults consisted of a wide cross-section of the community, whereas younger participants were largely undergraduate students who volunteered in return for course credits, although no evidence suggests that educational levels are related to pedestrian behaviour.

2.2. Materials

The questionnaire design was based on previous TPB road safety related questionnaires in which a selection of situations are presented, each followed by a series of questions asking the participant to imagine themselves in the situation (e.g., Evans and Norman, 1998). A selection of general measures and questions about demographic variables were also included but only the variables of age, gender, and driver status were relevant for these analyses. The situations were as follows:

2.2.1. Situation A

You are shopping in town and find yourself on the opposite side of the road of a shop you wish to visit. Further along the road

Table 1
Number of participants by age, gender, and driver status

Age group	Male ($n = 134$)		Female ($n = 159$)		Total
	Driver	Nondriver	Driver	Nondriver	
17–24 years					
N	24	15	21	23	83
Mean age	19.92	19.67	19.43	18.65	19.40
S.D.	1.84	1.92	1.78	1.023	1.70
25–59 years					
N	23	15	24	20	82
Mean age	37.22	38.31	36.83	36.35	37.11
S.D.	10.50	10.58	8.97	11.70	10.24
60–74 years					
N	19	9	21	16	65
Mean age	67.32	70.00	67.62	65.25	67.28
S.D.	3.51	5.48	4.42	3.89	4.36
75+ years					
N	20	9	20	14	63
Mean age	78.65	78.11	77.90	79.86	78.60
S.D.	3.47	12.09	1.65	4.19	5.25
Total					
N	86	48	86	73	293

is a set of traffic lights where other pedestrians are waiting to cross. Crossing at the traffic lights would mean you walk further away from the shop, so instead you hurry straight across during a gap in the traffic.

2.2.2. Situation B

You see someone you know on the other side of a busy dual carriageway. You look for a gap in which to cross but the traffic is very heavy and the road is never clear both ways. When one side of the carriageway is clear you walk to the middle of the road and wait for the other direction to become clear. Eventually there is a gap and you run across to meet your friend.

2.2.3. Situation C

You are standing on the bend of a street which has poor visibility either side. There appears to be no traffic so you walk across the road.

The situations were compared in a small pilot study to ensure that they did differ in terms of perceived risk. Ten pilot participants (aged 25–59) were asked to rank the three situations in terms of the likelihood of getting run over, the stress or anxiety they would feel crossing in the manner described, and their overall rating of risk of the situation. Using repeated measures analysis of variance followed by post hoc *t*-tests to compare individual situations to examine the differences, Situation A came out strongly as the situation judged to be least risky, least likely in which to get run over and least stressful (all significant at $p < .01$). Situations B and C did not differ significantly on any criterion, but participants rated the likelihood of being run over as highest in Situation C. Given that B did not differ significantly from C, and also given that some respondents found B to be ambiguous, Situation B was omitted from further analyses.

The same questions were asked for each situation (in some cases slightly reworded to take into account the specific situation). Each question was answered on a 7-point Likert scale with labels such as "likely/unlikely"; "strongly agree/strongly disagree" at either end.

Questions for the different constructs were distributed randomly throughout the questionnaire in order to reduce bias due to one item cueing response for the next. Different scale endpoints were used throughout, as appropriate, to reduce any anchoring effects and automatic response set, and to increase the cognitive processing involved in each question. This included some reverse coded items, with scores being standardized during data entry to ensure consistent directional coding.

Behavioural intention was assessed separately for A and C by a mean of four items: "How likely is it that you would cross the road as described in the situation"; "I would expect to cross the road in such a situation"; "It is likely that I will cross the road in such a way in the future"; "How likely is it that a situation will arise in the next month when you would cross in this manner?". Principle components analysis identified just one component accounting for 72% of the variance (eigenvalue of 2.91). Cronbach's alpha (α) was .87, indicating strong inner consistency.

The indirect measure of attitude was constructed using three items assessing beliefs about the outcome of the behaviour multiplied by evaluation of each outcome. The beliefs were: "Crossing the road in this way would get me to my destination more quickly", "If I crossed the road in this way it would save me time", and "Crossing the road in this way would irritate drivers". A mean of the three combinations was entered into the analysis.

Principle components analysis identified a single coherent component, accounting for 62% of the variance (eigenvalue of 1.87). Cronbach's alpha was lower than that for intention ($\alpha = .63$) but still indicates reasonable internal consistency. Nunnally (1978) suggested that $\alpha = .70$ represents strong inner consistency, but Cortina (1993) urges researchers to consider the number of items used—a moderate alpha with small number of items (as here) may well represent better internal consistency than a larger alpha with a larger number of items (see also Rhodes et al., 2004). Ajzen (2002) suggests that a requirement for high internal consistency for belief based measures is not necessary, given that it is the aggregate of differing beliefs that forms an attitude. The principle components analysis showing that the aggregated variable forms a unitary component is an important justification for aggregation.

The indirect measure of subjective norm was constructed using two measures of belief about the opinions of salient others multiplied by the motivation to comply with these beliefs. These were "My friends would think I should cross the road in this way" and "Other pedestrians would think I should cross the road in this way" Again, principle components analysis revealed one component accounting for 70% of the variance (eigenvalue = 1.40). Cronbach's alpha indicated moderate internal consistency, again in line with expectations for such a belief based aggregate, $\alpha = .57$.

Factors that may be hypothesised to contribute to an indirect measure of PBC were examined, taking into account perceived control beliefs and perceived difficulty of performing the behaviour. One key control factor that pilot work revealed as having the potential to affect whether a pedestrian would walk further to a safer place to cross was perceived mobility, i.e., ability to walk short distances. However, initial analysis revealed that an outcome evaluation combination of this with the control belief power measure "I would have to walk across the road in this way as it would be uncomfortable for me to walk to the traffic lights" was simply not possible given that so few people reported any difficulty with walking short distances. In line with the previous pedestrian work, a direct aggregate measure was therefore attempted, based on items used in previous studies on pedestrian road crossing intentions (Evans and Norman, 1998, 2003): (i) "I would have to walk across the road in this way as it would be uncomfortable for me to walk to the traffic lights"; (ii) "It is mainly up to me whether I cross the road or not in this situation"; (iii)"Refraining from crossing the road in this way would be easy/difficult"; (iv) "Would you be more or less likely to cross the road in this situation if you were with a friend?"; (v)"Would you be more or less likely to cross the road in this situation if you saw other pedestrians crossing there?"; (vi) "Would you be more or less likely to cross the road in this way if you were in a real hurry?". However, given that these items did not form a

coherent factor in principle components analysis, item (iii) was used alone, again, in line with other studies in this area (e.g. Evans and Norman, 1998, 2003), and chosen as the item most akin to the concept as outlined by Ajzen (1991) who described it as the "perception of the ease or difficulty of performing the behaviour of interest" (p. 183), and as a measure of self efficacy in relation to the behaviour at issue.

Two items were combined to form a measure of affective attitudes. These were "If I did cross the road in this way it would be satisfying . . . unsatisfying; and enjoyable . . . unenjoyable". These formed one component in a principle components analysis accounting for 79% of the variance ($\alpha = .72$). Ajzen's (1991) presentation of evidence for the discriminant validity of separate evaluative and affective predictors was confirmed here with a principle components analysis on a large number of attitude measures given by these participants in these pedestrian contexts, assessed as part of a larger ongoing study.

In order to measure perceived risk, the item "Crossing in this way and getting run over is likely . . . unlikely" was assessed for each of the situations.

2.3. Procedure

The study was given ethical approval by Aston University and conformed to ethical guidelines set out by the British Psychological Society. Volunteers responded to advertisements in and around Aston University, in Birmingham city centre, or to a postal request to members of the University of Warwick Ageing Studies Panel. Some took information (either a questionnaire or information on how to request a questionnaire) from public waiting areas in the University, for example, at the University's vision clinic where many older Birmingham residents come for free eyesight examinations (not a visually impaired group). The methods of volunteering do not enable a response rate to be calculated. Respondents were re-assured that there were no right or wrong answers.

3. Results

Numbers of participants within each cell were not equivalent, with particularly small numbers of men who did not drive (see Table 1). This is in line with demographic expectations, but does represent a difficulty for analysis. Initial analyses indicated that there were no age effects or interactions involving significant differences between the older old group (75+) and the younger old group (60–74) and so for the analyses of variance models described here, this group was collapsed into one over 60s group. For the regression analyses, separate groupings were retained, given that published accident data shows different levels of risk for people aged over 75 years.

Aim 1 regarding age, gender and driving status group differences in intention to cross in the two situations was addressed by four-way mixed analysis of variance. An indication of effect size is provided by partial η^2 where .10, .30 and .50 represent a small, medium and large effect size, respectively (Cohen, 1992, see also Armitage and Conner, 2001). Small effect sizes are anticipated, given the small range of responses available.

Table 2
Means (S.D.) for intention to cross by age group and situation

Age group	*N*	Situation A	Situation C	Overall
17–24 years	83	2.80 (1.16)	3.98 (1.56)	3.39 (1.13)
25–59 years	82	3.13 (1.69)	4.36 (1.89)	3.75 (1.51)
60+ years	128	4.12 (1.85)	5.12 (1.78)	4.60 (1.51)
Overall	293	3.47 (1.73)	4.58 (1.81)	4.02 (1.50)

Note: a higher score indicates that a person was more likely to refrain from crossing.

3.1. Intention to cross

The means of intention to cross are shown in Table 2. People were more likely to say they would cross in Situation A than in C, in accordance with the pilot data which had suggested that A was the least risky and anxiety provoking, $F(1, 281) = 94.68$, MS = 162.80, $p < .01$, partial $\eta^2 = .25$.

Intention to cross decreased with increasing age, $F(2, 281) = 20.89$, MS = 83.53, $p < .01$, partial $\eta^2 = .13$. Post hoc tests (Dunnett's *C*) showed that age groups 17–24 and 25–59 were significantly more likely to intend to cross overall than the over 60s. There was no effect of gender or driver status, or any significant interactions.

3.2. Additional variable: perception of risk

Aim 2 was addressed by examining whether the demographic groups differed in their perception of risk overall, and whether they perceived different situations in the same way. In line with the pilot study, participants perceived there to be a greater likelihood of getting run over in Situation C as opposed to Situation A, $F(1, 281) = 46.61$, $p < .001$, MS = 94.97, partial $\eta^2 = .14$, and women perceived there to be a greater risk of being run over generally than did men, $F(1, 281) = 8.67$, $p < .01$, MS = 46.95, partial $\eta^2 = .03$. There was no age effect, and no interaction between any of the grouping variables and the situations.

3.3. TPB predictors and affective attitudes

Aim 3 was addressed by examination of individual predictors of intention using repeated measures analyses of variance to determine whether the components differ between groups and between situations. There were significant differences between the situations for all TPB variables and for affective attitudes, with $p < .05$ in all cases, but effect sizes were small, varying between .02 for the combined measure of attitude, to .19 for affective attitudes. The results are summarised in Table 3.

The results were in the direction expected given the differences in intention: for Situation C, people had more negative attitude, perceived higher control, were less likely to believe other people would think they should cross (weighted by motivation to comply) and had more negative affective attitudes than for Situation A. There were also significant age group effects for each measure ($p < .01$), with post hoc tests (Dunnett's *C*) indicating significant differences between the under 60s and over 60s for attitude and PBC measures, between under 25s and the over

Table 3
Summary of analyses of variance for the TPB predictor variables and the added variable, affective attitudes

Source	Attitudes (BB × OV)	PBC	Subjective norm (NB × MC)	Affective attitudes
Situation	$F(1, 273) = 4.83^{*}$, partial $\eta^2 = .02$	$F(1, 281) = 19.00^{**}$, partial $\eta^2 = .06$	$F(1, 281) = 27.97^{**}$, partial $\eta^2 = .09$	$F(1, 281) = 64.38^{**}$, partial $\eta^2 = .19$
Age group	$F(2, 273) = 16.23^{**}$, partial $\eta^2 = .11$	$F(1, 270) = 6.52^{**}$, partial $\eta^2 = .04$	$F(1, 281) = 10.79^{**}$, partial $\eta^2 = .07$	$F(1, 281) = 12.57^{**}$, partial $\eta^2 = .08$
Gender	$F(1, 273) = 5.03^{*}$, partial $\eta^2 = .02$			$F(1, 281) = 10.94^{**}$, partial $\eta^2 = .04$
Driver status	$F(1, 273) = 4.77^{*}$, partial $\eta^2 = .02$			
Age group × gender	$F(2, 273) = 4.80^{*}$, partial $\eta^2 = .03$	$F(1, 281) = 3.91^{*}$, partial $\eta^2 = .03$		
Situation × age group	$F(2, 273) = 3.73^{*}$, partial $\eta^2 = .03$			
Situation × gender				$F(1, 281) = 4.60^{*}$, partial $\eta^2 = .02$
Situation × driver status	$F(1, 273) = 6.04^{*}$, partial $\eta^2 = .02$			
Situation × driver status × age group	$F(2, 273) = 10.73^{**}$, partial $\eta^2 = .07$			
Situation × age group × gender × driver status				$F(1, 281) = 3.59^{*}$, partial $\eta^2 = .02$

$^{*}p < .05$; $^{**}p < .01$.

60s for the measure of subjective norm, and between under 25s and the 25+ groups for affective attitudes. Men displayed more positive affect and had more positive attitudes than women, and nondrivers had more negative attitudes towards crossing than drivers.

Table 3 indicates a complex series of interactions for attitudes and these are illustrated in Fig. 1. The figure suggests that a key feature is the very negative attitude towards crossing reported by the older nondrivers in Situation A. The interactions were assessed with further analyses of variance and *t*-tests as appropriate, with Bonferroni's correction applied, as follows:

- *Age group* × *gender*: The difference between the genders was significant only for 25–59 year olds, $F(1, 80) = 6.75$, $p < .01$, partial $\eta^2 = .08$.
- *Age group* × *situation*: There were significant differences between Situations A and C for the two age groups under the age of 60, $t(82) = -2.53$, $p < .017$ and $t(81) = -2.82$, $p < .01$ respectively, but not for the over 60s.
- *Age group* × *driver status* × *situation*: Drivers had more negative beliefs about Situation C than A, $F(1, 169) = 15.74$, $p < .001$, partial $\eta^2 = .09$, but nondrivers did not differ, $F < .001$. In addition, older nondrivers had more negative attitudes towards Situation A, $F(2,120) = 15.44$, $p < .001$. The difference between drivers and nondrivers was only significant for the over 60s, $F(1, 126) = 7.68$, $p < .01$, partial $\eta^2 = .06$.

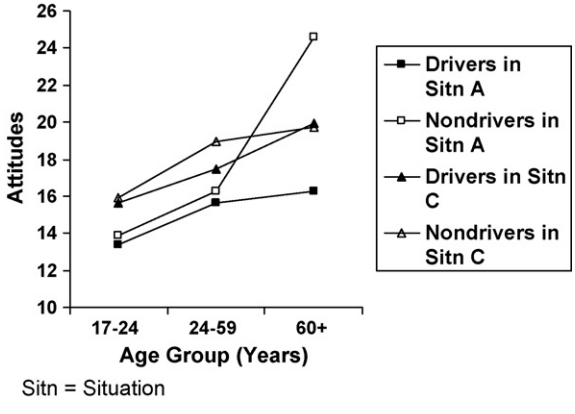

Fig. 1. Figure illustrating the situation × age group × driver status interaction in attitude (behavioural beliefs × outcome evaluation). Sitn: situation.

The age group by gender interaction for PBC was a result of the increase in perceived ease of refraining from crossing seen with increasing age occurring at an earlier age for women than for men, resulting in a smaller age effect for women (see Fig. 2). There was only a significant gender difference for the middle age group, $F(1, 80) = 6.46$, $p = .013$, partial $\eta^2 = .08$, women reporting that refraining from crossing would be easier.

The interactions between situation and gender, and between situation, gender, age group and driving status for affective atti-

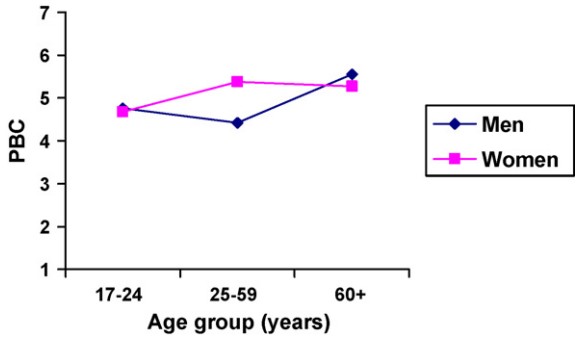

Fig. 2. Figure illustrating the interaction between age group and PBC.

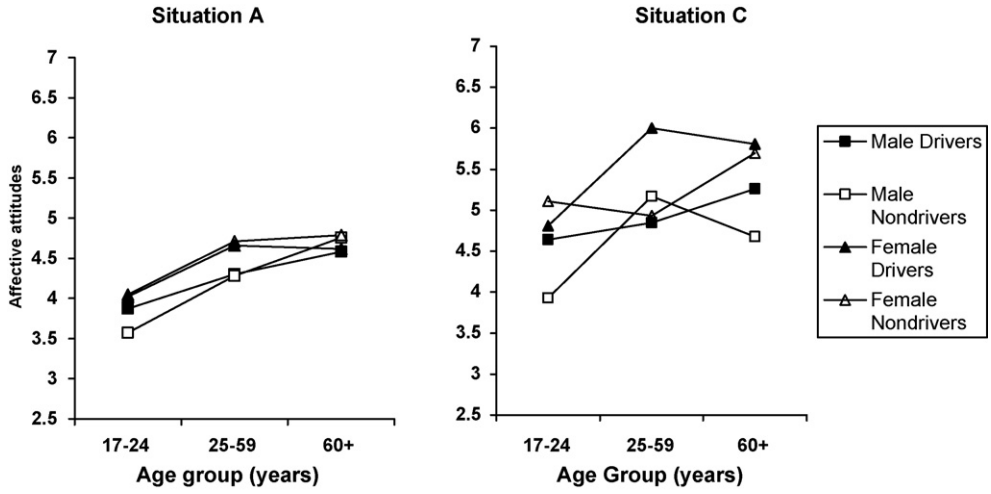

Fig. 3. Figure illustrating the four-way interaction in affective attitudes.

tudes are illustrated in Fig. 3. The figure suggests that a key influence was the more positive manner in which the youngest group viewed crossing the road, especially in Situation A (note that a mean of less than 4 suggests a net positive affective attitudes reported). For Situation C, this effect was only clear for young men who did not drive. Female drivers, especially the over 60s, reported the most negative affect in Situation C. For Situation A there was no difference between men and women, but for Situation C there was, $F(1, 292) = 15.74$, $p < .001$, with men in this situation reporting significantly more positive affect than women.

In order to address Aim 3, initial examination of the relationships between the TPB and demographic variables and intention was made using correlations (Table 4).

TPB variables, affective attitudes and perceived risk are all strongly related to intention to cross in both situations in the directions anticipated. People who had a more negative attitude were less likely to intend to cross, as were people who felt able to refrain from crossing (PBC) and those who thought that significant others would think they should not cross (combined with a motivation to comply with this). Perception of risk appeared to have a stronger relationship for the situation perceived to be more risky (C). However, using the z_r transformation to examine the difference between correlations (e.g. see Edwards, 1979), this difference was not significant ($Z = 1.52$).

Table 4
Correlations between intention to cross and group, demographic and TPB variables

TPB or demographic variable ($n = 278$)	Situation A	Situation C
Behavioural beliefs × outcome evaluation	.58**	.55**
PBC	.44**	.42**
Normative beliefs × motivation to comply	.56**	.57**
Affective attitudes	.63**	.55**
Perceived risk	.41**	.51**
Age	.38**	.29**
Gender	.12*	.04
Driving status	.06	−.05

*$p < .05$; **$p < .01$. The higher the score on the intention variable, the less likely the person was to say they would cross (i.e. perceived more risk).

It may be that the TPB variables have a different pattern of influences depending on the perceived risk of the situation. To examine this, Aim 3 was then further explored using hierarchical regression analyses to determine how well the model, the added variables of affective attitudes and perceived risk, and the grouping variables predicted intention to cross in the two situations of differing risk. Attitude (behavioural beliefs × outcome evaluation), subjective norm (normative beliefs × motivation to comply), and PBC were entered at Step 1, affective attitudes at Step 2, perceived risk at Step 3 and age group, gender and driver status at Step 4. The analysis was done separately for each of the two situations. The additional and demographic variables were added after the TPB variables in order to determine whether they added further variance to the model once the TPB contribution had been accounted for (e.g. see Parker et al., 1992b). The results are summarised in Table 5.

Each of the traditional TPB variables added significantly and independently to the total amount of variance in intention to cross predicted by the model. The additional variable, affective attitudes, also added significantly to the model (adding 12% in Situation A, 6% in C), as did perceived risk (adding 1% in Situation A, 3% in C). In total, the model assessed predicted over 65% of the variance in intention to cross in Situation A (less in C: 56%). Driver status did not add significantly to the model, gender had a significant impact in Situation A only and age group had a significant impact in both. Attitude and affective attitudes were less important predictors of intention to cross in Situation C than in A. Using a *t*-test of the difference between unstandardised beta weights (Edwards, 1979), the difference between situations for attitude was significant, $t(561) = 24.85$, $p < .001$, but that for affective attitudes was not, $t(561) = 1.29$. Perceived risk seemed more important in Situation C, although again this difference was not significant, $t(561) = 1.40$.

In order to examine whether the model differed for the different age groups, in answer to Aim 4, separate regression analyses were computed for the different age groups. As there were no

Table 5
Multiple regression: predicting crossing intentions using TPB and demographic variables

Step	Predictor	Situation A			Situation C		
		R^2	B	β	R^2	B	β
	Attitude (BB × OV)	.51	.08	.40**	.46	.07	.34**
1	PBC		.20	.20**		.20	.20**
	Subjective norm (NB × MC)		.06	.34**		.05	.33**
2	Affective attitudes	.63	.49	.39**	.52	.37	.28**
3	Perceived risk	.64	.07	.08*	.55	.19	.20**
	Age group	.65	.15	.10*	.56	.15	.09*
4	Gender		−.32	−.09*		−.22	−.06
	Driving status		.02	.01		.06	.02

*$p < .05$; **$p < .01$. BB: behavioural beliefs; OV: outcome evaluation; NB: normative beliefs; MC: motivation to comply.

Table 6
Comparison of regression models across the age groups

Step	Predictor	1. 17–24 years ($n = 83$)			2. 25–59 years ($n = 81$)			3. 60–74 years ($n = 59$)			4. 75+ years ($n = 59$)		
		R^2	B	β	R^2	B	β	R^2	B	β	R^2	B	β
	Attitude (BB × OV)	.32	.06	.27**	.65	.08	.44**	.53	.10	.48**	.42	.07	.38**
1	PBC		.11	.13		.15	.17*		.33	.29**		.22	.20
	Subjective norm (NB × MC)		.06	.40**		.06	.41**		.02	.13		.05	.24
2	Affective attitudes	.48	.57	.45**	.69	.30	.23**	.60	.39	.29**	.59	.58	.47**
3	Age	.50	−.03	−.04	.73	.03	.18**	.60	−.01	−.04	.60	.04	.10

*$p < .05$; **$p < .01$.

major differences between the situations in overall regression models, the two situations were combined for this analysis. Results of these regressions are shown in Table 6.

The measure of perceived risk did not add significantly to the variance predicted for any group, and neither did driver status or gender and so the regressions are reported without these variables. Four clear differences between the age groups emerged. First, although the model was a very good fit for all age groups (accounting for between 50 and 73% of the variance), more variance is accounted for in the three older age groups (25 years old and older) than in the younger group 1 (17–24 year olds). Second, subjective norm does not account for a significant independent amount of the variance for the two older groups (but does for the younger groups). There is an important distinction to make here, as the above analyses on the group differences showed that the normative beliefs × motivation to comply measure was more negative for older people, but it is clear that this belief does not actually predict intention for older groups as much as for younger people, $t(289) = 144.14$, $p < .001$. Third, the contribution of PBC to the model for the younger old group (60–74 years) was markedly greater than that for other age groups (e.g., $\beta = .29$, as opposed to $\beta = .20$, for the oldest group, $t(124) = 3.93$, $p < .001$), suggesting that independent decision-making was an important contributor for this group specifically. Fourth, age was only included in the model by the analysis (which excluded F ratios of less than or equal to .05) for the middle aged group (25–59 years). This may be due to the larger age range in this middle group. Finally, affective attitudes added significantly to the equation for all age groups.

The group differences suggested that other demographic factors may have an impact on factors predicting intention to cross, within the group of TPB variables. The following analyses exam-

Table 7
Comparison of regression models across gender and driver groupings

Step	Predictor	Female nondrivers ($n = 72$)			Female drivers ($n = 85$)			Male nondrivers ($n = 47$)			Male drivers ($n = 83$)		
		R^2	B	β	R^2	B	R^2	B	β	R^2	B	β	
	Attitude (BB × OV)	.61	.08	.45**	.48	.11	.42**	.41	.06	.33**	.63	.09	.42**
1	PBC		.28	.27**		.19	.18		<.01	<.01		.23	.24**
	Subjective norm (NB × MC)		.05	.31**		.05	.29**		.06	.44**		.05	.32**
2	Affective attitudes	.65	.34	.25**	.59	.52	.40**	.64	.80	.56**	.69	.36	.28**
3	Age	.68	.01	.17*	.60	.01	.08	.66	.01	.16	.69	.01	.10

*$p < .05$; **$p < .01$.

ine the regressions separately for mutually exclusive groups (Table 7).

First, chronological age was only a significant predictor of intention to cross for female nondrivers, although the t-test comparison showed no significant difference from male nondrivers. Second, PBC was not a significant predictor for male nondrivers or female drivers, specifically having almost negligible β values for male nondrivers. Third, affective attitudes is a significant predictor for all groups, but added a massive 23% of variance accounted for in the equation for male nondrivers. Finally, subjective norm seemed less important for the women in the sample than for the men, regardless of driver status, although the *t*-test examining the difference between men and women overall was not significant, $t(289) = .02$.

4. Discussion

In answer to the first aim, findings confirmed previous indications (Hamed, 2001) that older people would be less likely to intend to cross. The younger two age groups did not differ, and, in contrast to Hamed (2001) there were no overall driver status or gender differences. A key issue these findings highlight is that pedestrian and driver risk-taking are not the same, since this finding is in stark contrast to the literature on driving where men, particularly young men, are more likely to report intention to commit risky driving behaviours (e.g. Holland and Conner, 1996; Parker et al., 1992a).

The second aim was to examine the possibility that demographic differences in accident data may be due to differences in perceptions of risk in the pedestrian traffic situations. The finding that women did generally feel that harmful outcome was more likely is consistent with the findings such as those of DeJoy (1992), that young men perceived risky driving behaviour to be less likely to result in an accident than young women did. However, all groups perceived the difference in risk between the two situations in the same way, and the lack of interactions between groups and situation suggests that differential perception of risk is not the cause of the differential accident data. The concept of the varying perception of risk and its effect on the TPB components has not been compared in relation to road safety scenarios, but those few studies in other areas that have examined perception of risk in this way, i.e. isolated the belief in the likelihood of harmful outcome, have also shown a relationship with intention, but not with other components of the TPB (e.g., De Wit et al., 2005). These results have important implications for road safety education as they illustrate that addressing beliefs about the riskiness of situations may be unnecessary. Although perception of risk predicts intention, people already know which situations are more risky than others, and in this study, this varied little between groups. However, Van der Plight (1996) suggested that the extent to which perceived risk affects intentions may be moderated by subjective norms, and so exploration of differences in the impact of subjective norms (and other variables that predict intention) is important. This leads on to the third aim.

The level of perceived risk did have an impact on the different components of the TPB. Where people perceived more risk they had more negative attitudes, were less likely to believe that others would think they should cross, and perceived higher control (most likely to report being able to refrain from crossing). This has significant implications for safety education, suggesting that the perceived risk of the situation will have an important influence on the success of addressing different predictors of intention or behaviour. Furthermore, the key issue in designing interventions is to be aware of group differences within these findings. Just as for intention, there were age effects for each of the predictor variables, but this was not a uniform age effect. For instance, subjective norm was particularly important for the youngest group, confirming findings from driver safety research (e.g., Conner et al., 2003). The finding that younger people, men and especially younger men who did not drive reported more positive affect towards crossing in the risky situations (the latter particularly so in the more risky of the situations), suggested important demographic differences which may well explain the apparent contradictions in the literature. For example, Evans and Norman's (2003) finding of the importance of affect in a pedestrian situation may have been a finding specific to their population (pre-driving adolescents) as may Conner et al.'s (2003) lack of effect with younger drivers. This finding of such demographic differences adds weight to our suggestion that drivers and nondrivers are not making decisions in the same way. The strength of the contribution of affective attitudes to intention in this study, additional to the contribution of TPB variables, confirms its importance as a separate additional predictor of intention in pedestrian behaviour, and also suggests that it may be a key area to address in road safety education aimed at younger male nondrivers in particular.

There were further confirmations of the suggestion that specific groups differed from others in the interaction terms identified. For example, the age by gender interaction for PBC fits with the earlier rise in serious accident rate for women than for men in statistical data (e.g. DfT, 2004a), and this greater PBC demonstrated by women in their middle years may be a reflection of awareness of feeling at risk. In terms of attitude, the very negative view of crossing in the less risky of the situations of older male nondrivers contrasted with the lack of difference in their attitudes towards the two situations for older people generally. Thus, there are differences, especially in the older age group, that are worthy of further investigation and that have implications for our efforts to understand the demographic differences in pedestrian accident likelihood outlined in the introduction. The perception of the utility of taking a risk to save time or of irritating drivers by one's own behaviour (our composite attitude measure) was perceived as more negative by these groups. In summary, although we have demonstrated that key differences between the groups were not a simple matter of understanding the risk of the situations, the perceived value of crossing in risky situations did differ between groups. Perceived value of taking a risk may be a key area to address in any road safety education for adults under the age of 60, and for drivers.

The implications of the results on value (behavioural beliefs) combined with those on PBC and other variables suggest that older people are less influenced by external factors and are more determined to cross safely than younger people. This has implications for road safety education and also for traffic environment

design and the sitting of pedestrian crossings, central refuges and other pedestrian facilities. However, the crucial question is what influence this has on actual intention to cross in the risky situations, and eventually, whether this predicts actual behaviour. This is the key indicator of what may be useful variables for road safety education and intervention.

Part of aim 2 was therefore to determine the extent to which the model differed between the situations in predicting intention. The model predicted 56–65% of the variance in intention to cross, slightly more than previous studies (e.g. Evans and Norman, 1998, were able to explain 39–52%). However, there were differences between the two situations that are worthy of highlighting. Gender only added significantly to the model once the TPB variables had been accounted for in the situation perceived to be the least risky. Perhaps this was a situation in which gender groups differed simply because there was more scope for decision making in this less risky situation. The other situation may have been perceived as so risky that respondents perceived less choice about whether they would sensibly cross in it. This factor may also explain the finding that the combined attitude measure added more variance to the equation for the least risky situation. Thus the study demonstrated that prediction of intention does differ according to the perceived risk of a situation, with attitudes and affect especially being a more important issue when risk is low. Practically, this suggests that an assessment of how risky a target behaviour (or outcomes of that behaviour) is perceived to be by the target group is a necessary precursor to any interventions that seek to change intentions and behaviour—changing attitudes is more relevant where less risk is perceived.

The fourth aim was to examine whether the prediction of intention differed for the different demographic groups. Although the amount of variance in intention to cross accounted for was substantial (over 49% in all cases), more variance was accounted for in the older groups than in the youngest group, suggesting that there are further variables not examined here which may predict intention to take risks specifically in younger people. For example, Evans and Norman (1998) found that self-identity added a significant amount to the variance predicted in intention to cross in two of their three scenarios (crossing against the red man at a pelican crossing, crossing a busy residential road by nipping between parked cars), and Evans and Norman (2003) also found self-identity to be a significant predictor for adolescents. Although this pedestrian study did not find a role for moral norm, previous studies, for example, on driving violations, suggests that moral issues of the rightness or otherwise of a decision may also play a part (Parker et al., 1995).

A key difference that has significant implications for road safety education with different age groups is that although the combined measure of subjective norm shows significant age differences, with older age groups showing stronger beliefs in significant others thinking they should not cross, this contributed much less to the model for the two older groups, than for the younger groups. Thus this research confirms previous findings in other areas of health education (e.g., prediction of intention to wear cycle helmets amongst adolescents by Quine et al., 1998; Lajunen and Räsänen, 2004; prediction of driving violations, Parker et al., 1992b) that have suggested that subjective norm was particularly important for younger groups, in some studies, particularly for young men (Parker et al., 1992b; Conner et al., 2003). This lack of influence of subjective norm for older people has also been found in other health education areas, e.g., a study examining use of the TPB to predict dairy consumption by older adults (Kim et al., 2003). This also points to a key difference between risky pedestrian decisions and risky driving decisions. Pedestrian accidents generally present the most negative consequences for the pedestrians themselves, rather than other people, whereas risky driving decisions, such as violations, have greater potential consequences for other road users. Rather than outcome measures such as risk, previous road safety studies, e.g., Parker et al. (1992b), suggest that, when a decision has more potential consequences for other people, rather than just the individual, a more important predictor may be subjective norm (see also Van der Plight, 1996). The difference between younger and older adults here may be a consequence of a different perception of risk between the two groups—older people may well be taking into account the fact that any pedestrian accident is likely to have very serious consequences for them as an individual, and younger and middle aged people may be more concerned about the consequences for family and friends, and future research that explores other indices of the perception of risk and impact of negative outcome (in addition to likelihood of getting run over, as here) may clarify this difference in the importance of subjective norm.

Outcome variables (attitudes and affective attitudes) particularly influenced intention for the oldest group. Other work with older women in particular has illustrated the importance of behavioural beliefs and outcome evaluation for this age group in intention to exercise (Conn et al., 2003) or to seek help for breast cancer symptoms (Grunfeld et al., 2003). However, previous research comparing the predictive patterns for young and old on the same material was not found. Our present findings indicate that even on the same questions and with similarly effective models, old and young participants do differ in which components of a TPB model are significant predictors. This finding is new and has significant implications for health education in this area, and it is suggested that replication in other areas would be beneficial to support the use of specific targeted health or safety education methods for different demographic groups.

There were also differences in the pattern of prediction of intention for demographic groupings based on driver status and gender. The finding of age only being a significant independent contributor to the model for female nondrivers links back to the issue of older women demonstrating a greater increase in pedestrian accident risk than men with increasing age, and the suggestion that this may be related to the fact that fewer older female pedestrians are also drivers. This finding does suggest that older women who do not drive are making decisions differently to those who do drive and this needs further investigation. The simple analyses on differences in the measures between the female drivers and nondrivers showed no differences; the way in which intention is predicted by the measures, as it varies with age, is the important issue. Although age was only a significant predictor of intention for female nondrivers, the difference in

the amount of variance accounted for by age between this group and the male nondrivers was not significant, and it may be suggested that the lack of significance of age in the equation for male nondrivers may be a result of the smaller numbers in this group. Thus we may conjecture that age could be a significant factor for all nondrivers. Nevertheless, men and women who did not drive did differ in other ways, for example, PBC did not contribute to the variance predicted for male nondrivers, and affective attitudes was a very important contributor for this group. Thus, we have intriguing differences between groups in what predicts intention to cross. Further research could usefully examine these distinctions, and their influence on actual behaviour or accident occurrence.

A limitation of this, and many other studies in the road safety area, is the fact that we have not examined the final link between intention and actual behaviour on the roads, with previous studies indicating that stated intentions do not always materialise into actual behaviour in the real world (e.g. Armitage and Conner, 2001). However, this study set out to examine predictors of intention with the express aim of establishing how the predictors differ in their importance for different demographic groups, and situations of precisely defined differential risk. This first stage is necessary to provide suggestions as to how to target and thus improve interventions for specific groups that attempt to change intentions by changing beliefs, and to demonstrate that such specific targeting is needed. Studies using the TPB to predict pedestrian behaviour were not found, but studies that have attempted to address behaviour in research on driving behaviour have used varying methods: self-reports of prior behaviour (Conner et al., 2003), concurrent observational behaviour (Holland and Conner, 1996), concurrent self-reports (e.g. Parker, 1997), prospective self-reports and simulator speeds (Elliott et al., 2003a,b). The next stage in research needs to examine the validity of these methods in relation to actual pedestrian behaviour. A further study of demographic differences is currently underway looking at actual road crossing decisions in a simulated environment. Other methods of dealing with this issue have been reviewed elsewhere (Ajzen et al., 2004).

A second limitation of the study is the wide age range in the middle group. The regression analysis showed that age within this group was a predictor of intention and suggested there may be differences within this age group that could be further explored by breaking down into smaller age ranges. This age group was chosen as it does show a relatively uniform low pedestrian accident risk, but it may be speculated that reasons for this low risk may not be the same throughout the age range. Further research would be necessary to determine the source of within group differences. The lack of age as a significant further predictor for the other groups suggests that these were coherent groupings and that selection of age divisions, originally based on differentiation in accident statistics, had been accurate.

A further limitation is the difficulty of finding appropriate formative beliefs for the measure of PBC. Pilot work indicated that an important control factor was ease of walking short distances, but so few people reported any difficulty with this that it could not be used. Further research could usefully explore appropriate control beliefs for the pedestrian situation.

A final limitation of the study was the smaller numbers of men who did not drive, although this is in line with demographic expectations (e.g. DTLR, 2001a). This could be overcome by specific recruitment of male nondrivers.

The findings of differences between groups in the levels of the TPB and additional variables have important implications. We have shown that pedestrian intentions and beliefs do not always mirror those found in road safety analyses in other areas such as driving, but where found, age and gender differences are generally in the directions expected based on previous research. However, the important factor for road safety education and intervention design is what factors actually predict behavioural intention, and this does not logically follow from differences in the levels of TPB variables for the different groups. For example, although older people reported that they believed significant other people to think they should not cross in the situations depicted, and that they were motivated to comply with this, this belief did not predict intention for this group.

Another key finding that needs further investigation, but that could potentially be important in designing interventions and in explaining demographic differences in accident likelihood are the differences between drivers and nondrivers, e.g. PBC was not a significant predictor for older male nondrivers, and age seemed an important predictor of intention for nondrivers. Finally, outcome (for example, behavioural beliefs by outcome evaluation, or affective attitudes) is a key factor for older groups.

4.1. Use of findings to develop behavioural change interventions and road safety education

Stead et al. (2005) point out that the use of TPB to develop interventions, rather than track their effectiveness, has yet to be fully exploited. The findings reported here illustrate clearly that the TPB based model tested strongly predicts intention in a pedestrian context, that perception of the risk of a situation does have influences on the roles of the different predictors, and that the roles of these predictors also vary in specific ways with different demographic groups. Targeting these factors can be done in a number of ways (see Fylan et al., 2006, for a review of theory-based interventions). Based on the findings of this study, and the review of intervention effectiveness by Fylan et al., an intervention to change aspects of the TPB model in order to change intention to cross in risky situations, and result in changes to actual behaviour, should:

- Focus on specific factors for different demographic groups, e.g., affective attitudes for younger men, especially younger male nondrivers, subjective norm for younger groups, or PBC and outcome evaluations for the oldest women.
- Determine the perceived risk of the target situation, in order to additionally inform which beliefs to target for change (e.g. attitudes were shown to be more important in the situation perceived to be less risky).
- Use a pre-intervention stage (e.g. Stead et al., 2005) to identify salient beliefs and norms within the TPB components,

e.g., who are the most influential subjective norm referents, what are the key issues affecting ease of refraining from the behaviour (PBC) for the target group, and to determine what the target group see as the most potentially useful formats (e.g., written versus multi-media).
- Incorporate a full TPB baseline survey to ensure that measures of change can be made.
- Use information, as well as attitude change manipulations, e.g., data on comparative risks of accident statistics addresses self-bias and feeling of invulnerability.
- Use models of attitude change to design methods that will actually result in change of the target beliefs. For instance, Fylan et al. (2006) suggest the Elaboration Likelihood Model (Petty and Cacioppo, 1986) involving an instruction phase which includes elaboration, e.g., group discussion, group action plans, peer group support.
- For groups for whom self-efficacy or PBC is a target (e.g. older women), include modelling of the behaviour (vicarious experience) and/or personal mastery aspects.
- Elicit specific implementation intentions specifying what the person intends to do in the specific situation, or to enable avoidance of crossing in the specific situation, providing suggestions of intentions if needed (e.g., do shopping in a different order so that crossing with a better view is less costly in terms of distance walked).
- Finally, a model of how to evaluate the success or failure of the intervention is needed, based on the theoretical issues (have beliefs changed, do they now predict intention in a different way, have intentions changed?) and also on behavioural data. The evaluation should provide a clear basis for detecting key sources of success or failure.

5. Conclusions

In conclusion, this study has shown clearly that the TPB provides a good model for predicting intention to cross roads in less than ideal circumstances, for all age, gender and driving status groups tested. We have confirmed previous findings suggesting that older people do take fewer risks, being less likely to intend to cross in risky situations. Significantly, we have demonstrated that different variables vary in importance in the prediction of intention to cross the road in less than ideal circumstances for different demographic groups. This has not been examined in previous research and has significant implications for the targeting of road safety education and also for determining components of the origins of demographic differences in accident statistics. We have also demonstrated that the impact of different factors in the prediction of intention differs according to amount of risk perceived. The implications of the study for differentiating the focus of road safety information for different age, gender and driver status groups is clear, but there are also implications for the potential benefits of ascertaining beliefs and perceptions of the risk or value of certain actions in particular situations before attempting to address intention to perform those actions.

Acknowledgements

We are grateful for the assistance of Lindsey Roberts who was supported during the piloting and initial stages of this project by the Wellcome Foundation Student Summer Bursaries scheme. We gratefully acknowledge the support of Elizabeth Maylor for access to and help in recruiting participants from the University of Warwick Ageing Studies participant panel, and Richard Cooke and Elisabeth Moores for comments on an earlier draft of this article. We are also grateful for the comments of two anonymous reviewers.

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