THE IMPACTS OF FUNCTIONAL PERFORMANCE, BEHAVIOUR AND TRAFFIC EXPOSURE ON ROAD-CROSSING JUDGEMENTS OF YOUNG CHILDREN

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ABSTRACT

Using data from i) a simulated road-crossing task, ii) a battery of functional performance assessments, and iii) a survey of parents, some factors that may predict poor road-crossing skill were identified. Children aged between 6 and 10 years made road-crossing decisions in a simulated road environment in which time gap and speed of approaching vehicles were manipulated. Functional performance was examined using a range of tools designed to assess cognitive, perceptual, attentional and executive functioning. Parents also provided information on physical activity, exposure to traffic and road safety education. The results suggest that children predominantly made decisions based on distance gap and that younger children (6-7 year olds) were 12 times more likely than older children (8-10 year olds) to make critically incorrect (or unsafe) crossing decisions. Factors found to be associated with incorrect crossing decisions included lower perceptual, attentional, cognitive and executive performance, and independent travel. There were no gender differences associated with incorrect crossing decisions. This study has used a novel and safe way to identify ‘at risk’ groups of children and the findings have been used to develop and evaluate a practical educational and training program aimed at improving essential skills and strategies to cross roads safely amongst ‘at risk’ children.
Walking is a major mode of transport, is a component of most trips and has obvious benefits for health and well-being of individuals and the environment. However, pedestrians are an extremely vulnerable road user group, largely due to their lack of protection and limited biomechanical tolerance to violent forces when impacted by a vehicle. Crashes involving pedestrians are, therefore, severe in nature and pedestrian safety is a serious community concern. Pedestrian trauma makes up approximately 14 percent of all road fatalities in Australia. Two hundred and twenty seven pedestrians were killed in 2006 and over 2,500 were seriously injured on Australia’s roads in 2002 [Australian Transport Safety Bureau, 2007]. Children under the age of 16 years constituted a substantial proportion of these deaths (13%) and a larger proportion of serious injuries (21%). Research suggests that younger children (between the ages of 6 and 10) are at highest risk of death and injury, with an estimated minimum four times the risk of collision compared with adult pedestrians [Struik, Alexander, Cave, Fleming, Lyttle & Stone, 1988; Thomson, 1996]. Moreover, pedestrian crashes are widely regarded as the most serious of all health risks facing children in developed countries [Malek, Guyer & Lescohier, 1990; Thomson, Tolmie, Foot & McLaren, 1996].

Promotion and education of safe walking practices have long been advocated as a means of promoting a healthy lifestyle and teaching children the skills to interact with traffic safely. In recent years, there has been a major push to promote safe walking and cycling in urban areas, particularly in Europe and in Australia [Dijkstra et al., 1998; Victorian Government 2006] and while common sense dictates that when young children are exposed to traffic, supervision is essential, there is little agreement on developmental milestones that allow independent travel, and very little information given to parents regarding the development of skills. Moreover, there are some concerns that road safety education of children may not be optimal. For example, Bailey (1995) pointed out that, on the rare occasions when road safety education is evaluated, it tends to focus on knowledge and attitudes derived from rote learning, rather than skills required to function in traffic environments. Of particular concern is the argument that young children’s ability to apply their knowledge to safer performance or improved behaviour is poor, and that transfer is not automatic [Zeedyk, Wallace, Carcary, Jones & Larter, 2001; Ampofo-Boateng & Thomson, 1991; Rothengatter, 1981]. Furthermore, education may produce negative effects in that the increased knowledge that children exhibit can create a false sense of confidence amongst parents and children that their ability to interact with traffic is improving.

It is also suggested that education and training programs are only moderately successful because these programs generally treat each child the same [Hoffrage, Weber, Hertwig & Chase, 2003]. Rather, it is argued that training programs should be specifically tailored for and
allocated to those who are most in need of training. However, there remains a large amount to be learned about children’s behaviour in traffic environments [Zeedyk & Kelly, 2003] and a better understanding of the developmental and behavioural characteristics that put young children at increased risk for pedestrian injuries. This information will be critical for development of more appropriate and targeted road safety education and training packages.

The current study aims to investigate the impacts of functional performance, behaviour, age and gender, and travel patterns and exposure to traffic on road-crossing skill amongst primary school children.

METHOD

PARTICIPANTS – Seventy-one children (35 males and 36 females) and their parents participated in the study. Children were aged between 6 and 10 years (13 six year olds, 14 seven year olds, 15 eight year olds, 15 nine year olds and 14 ten year olds) and were recruited through five randomly selected government primary schools in the Melbourne metropolitan area. Parents provided informed consent for their participation and their child’s participation.

SIMULATED ROAD-CROSSING ENVIRONMENT – Simulated traffic scenes generated from a mid-range driving simulator were used to elicit road-crossing responses. All scenes showed an undivided, straight two-way residential road (with visual and audio features to make the environment as realistic as possible) from the perspective of a pedestrian waiting at the kerb, with two approaching vehicles travelling from the right-hand side (near-side lane in Australia). No approaching traffic was visible in the far-side lane.

Time gap and speed of the vehicles were systematically manipulated with five levels of time gap (3, 4, 5, 6, and 7 secs) and three levels of vehicle speed (40, 60 and 80kph) resulting in fifteen different traffic scenarios. Distance co-varied as a function of these two manipulations. Each of the 15 traffic scenes was shown three times, therefore each participant viewed a total of 45 scenes presented in random order. Traffic scenes were projected onto a large white screen.

Participants were seated at a desk in a darkened quiet room approximately 2m in front of a projection screen and with a computer keyboard placed in front of them. Practice trials were provided where the experimenter demonstrated the simulator task verbally and trials were given until participants indicated that they fully understood the task. Each participant was instructed to look at the traffic scene and, as soon as they heard a buzzer (sounded when the first approaching vehicle passed the point of crossing and which activated a timer), to indicate whether or not they would ‘cross’ in front of the second vehicle, responding as quickly as possible using the ‘J’ or ‘D’ keys labelled ‘YES’ and ‘NO’
respectively. This response deactivated the timer and the time interval was recorded as decision time. The keys for numbers 1 to 9 with labels ‘very unsafe’ below the 1 key and ‘very safe’ below the 9 key provided a nominal rating scale on which participants were asked to rate the safety of the road-crossing.

FUNCTIONAL PERFORMANCE MEASURES – Participants also completed a battery of neuropsychological tests designed to assess cognitive, perceptual, attentional and executive functioning. In addition, parents completed a rating scale of their child’s attentional behaviour. The assessments are outlined in Table 1.

Walking time over a distance equivalent to the width of an average road lane (5.6m) at two walking paces (normal and fast) was also measured.

PARENT SURVEY – Parents of children in the study completed a questionnaire is designed to gather information about the child’s general activity and exposure to traffic, particularly the amount of walking undertaken to and from school, amount of physical activity out of school, amount of supervised and unsupervised walking, parent safety practice, presence of home education on road safety, and parent attitudes to road safety.

Analysis of the data was undertaken using preliminary bi-variate tests and employing hierarchical logistic regression modelling to examine the impacts of age and gender, functional performance and traffic exposure on road-crossing responses.
<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
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</table>
| **Tower of London**  
[Culbertson & Zillmer, 1998] | The ToL measures higher order problem-solving ability. The information it provides is not only useful when assessing frontal lobe damage but also when evaluating attention disorders and executive functioning difficulties. Participants are asked to arrange beads on a tower-structure board to match a configuration in a diagram presented to them. Scores are calculated for total correct, total moves, total initiation time, total execution time, total time violations and total rule violations. |
| **Children’s Colour Trails Test**  
[Llorente, Williams, Satz & D’Elia, 2003] | The Children’s Colour Trails Test measures visual search, sustained attention, sequencing, and other executive functions. In Part 1, participants are asked to connect, sequentially and as fast as possible, numbered and circles that are randomly scattered over a page (odd numbers in a yellow circle and even numbers in a pink circle). In Part II, each number is printed twice, once in a pink and once in a yellow circle. Participants are asked to connect circles in consecutive order from 1 to 25, by alternating between pink and yellow circles. Scores are calculated for total execution time for each part and total number of errors. Total time to complete each part is recorded, along with number of errors. |
| **Motor-Free Visual Perception Test, Version 3 (MVPT-3)**  
[Colarusso & Hammill, 2003] | The MVPT-3 assesses an individual's visual-perceptual ability with no motor involvement needed to make a response. Participants are shown a series of line drawings. Each stimulus contains one complete drawing and a number of incomplete drawings. Participants are required to identify the correct response from incomplete drawings to match the complete drawing. Scores are calculated for total number of items correctly identified. |
| **Connors’ Parent Rating Scale** (Connors, 1997) | The Connors’ Parent Rating Scale is completed by a parent about their child and assesses conduct, cognitive, anxiety and social problems and attention-deficit/hyperactivity disorder. Parents are given list of 27 common problems that children have, e.g., ‘inattentive, easily distracted’, ‘fails to complete assignments’, has trouble concentrating in class’. They are asked to rate each item according to their child’s behaviour in the last month on a scale of 0 (not true at all) to 3 (very much true). |
RESULTS

ROAD-CROSSING DECISIONS – Road-crossing decisions were analysed in terms of simple yes/no responses and in the context of whether the response was a correct (safe) or incorrect (unsafe or missed opportunity) decision, based on average walking speed and characteristic of the scene (i.e. time gap and vehicle speed). While decision time is considered an important factor in decisions in a real road-crossing environment, and therefore was recorded, during experimentation it was apparent that many children made their decision long before they responded by pushing the button. Because of these disproportionately long decision times, this variable was not considered to be a reliable measure of the time taken to make a decision.

Figure 1 shows the proportion of positive crossing responses by vehicle condition for age group (gender is not shown as there were no significant differences). These data show that all children were less likely to indicate that they would cross when time and distance gaps were small than when they were larger. However, some group differences were apparent. For example, a large proportion of younger children (52%) indicated that they would have crossed the road in a three second time gap (for all vehicle speeds), even though most of the children required longer than three seconds to walk the distance of the carriageway even at their fastest pace. On average, 6-7 year olds took 5.3 secs to walk the distance of an average lane width at a normal walking pace and 3.65 secs at a fast walking pace. In comparison, only 9 percent of older children indicated that they would have crossed in these traffic conditions. On average 8-10 year olds took 5.0 secs to walk the same distance at a normal walking pace and 3.2 secs at a fast walking pace.

Figure 1 – Proportion of ‘yes’ responses as a function of age group, vehicle speed, time gap and distance gap.

Figure 1 also indicates that distance, not time gap was a strong
determinant of crossing decision for both groups of children. Vehicle speed was also taken into account, but to a lesser extent. For instance, for the three 4 sec time gap conditions the proportion of positive responses increased for both groups as the distance gap increased. For the younger group, 74 percent indicated that they would have crossed in the higher vehicle speed condition (80kph), compared with 47 percent in the lower vehicle speed condition (40kph). This was even more pronounced in the older group, with 68 percent responding positively in the higher vehicle speed condition and only 26 percent in the lower vehicle speed condition.

While a ‘yes’ or ‘no’ response is an interesting measure in itself, the response needs to be put in context of whether it was a correct (safe) or incorrect (unsafe or missed opportunity) decision, allowing for walking speed. Allowing for fast walking speeds, responses were scored in one of four possible categories: correct acceptance (safe), correct rejection (safe), incorrect acceptance (unsafe), incorrect rejection (missed opportunity). The fastest walking speed was chosen over normal walking speed because, as in real life situations, any pedestrian is likely to increase their walking speed if a vehicle is quickly approaching. The proportions of responses by age group are shown in Table 2.

Table 2 – Proportion of correct and incorrect responses by age

<table>
<thead>
<tr>
<th></th>
<th>Correct acceptance</th>
<th>Incorrect acceptance</th>
<th>Correct rejection</th>
<th>Incorrect rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 year olds</td>
<td>295 (52.0%)</td>
<td>99 (17.5%)</td>
<td>56 (9.9%)</td>
<td>117 (20.6%)</td>
</tr>
<tr>
<td>7 year olds</td>
<td>341 (55.2%)</td>
<td>47 (7.6%)</td>
<td>74 (12.0%)</td>
<td>156 (25.2%)</td>
</tr>
<tr>
<td>8 year olds</td>
<td>434 (66.2%)</td>
<td>42 (6.4%)</td>
<td>67 (10.2%)</td>
<td>113 (17.2%)</td>
</tr>
<tr>
<td>9 year olds</td>
<td>395 (59.0%)</td>
<td>32 (4.8%)</td>
<td>64 (9.6%)</td>
<td>178 (26.6%)</td>
</tr>
<tr>
<td>10 year olds</td>
<td>377 (61.1%)</td>
<td>16 (2.6%)</td>
<td>43 (7.0%)</td>
<td>181 (29.3%)</td>
</tr>
<tr>
<td>Total</td>
<td>1842 (58.9%)</td>
<td>236 (7.5%)</td>
<td>304 (9.7%)</td>
<td>745 (23.8%)</td>
</tr>
</tbody>
</table>

Approximately 60 percent of participants indicated that they would have crossed when it was safe to do so. However, the most important response to examine here is an incorrect acceptance, as this response would have resulted in a collision, or the driver needing to take aversive action to avoid a collision in a real-world situation, had a child decided to cross the road with a time gap shorter than their fastest walking speed. Of the total number of traffic scenes shown to participants, 540 scenes were considered ‘unsafe’ (based on individual fast walking speeds). Of these 540 scenes, there were 236 (44%) ‘yes’
responses made. Forty-two participants (59%) made at least one critically incorrect decision.

Younger children were more likely than older children to have indicated that they would have crossed in these risky conditions. To determine what variables influenced a critically incorrect response, logistical hierarchical multiple regression modelling was employed including the variables age, gender, time gap, and vehicle speed. The model revealed that all factors, except gender, were significant predictors of crossing responses: age, $\chi^2(4) = 119.62$, $p<0.001$; time gap, $\chi^2(1) = 415.43$, $p<0.001$; vehicle speed, $\chi^2(1) = 6.67$, $p<0.01$. Six year old children were 11.96 times more likely to make a critically incorrect decision than 10 year old children, $p<0.001$, with an average of 8.25 critical errors per 6 year old participant compared with an average of 1.33 critical errors per 10 year old participant.

FUNCTIONAL PERFORMANCE – Mean scores on tests of functional performance by age group are presented in Table 3. Preliminary analyses comparing the performance of younger children with the performance of older children on assessments were conducted using t-tests. In general, the older children performed significantly better than the younger children, particularly on the Tower of London test and both the Trails tests. Older children were also less likely to have rated highly on two of the Connors Rating Scale components (the oppositional and hyperactivity scores). Significant correlations were found between the MVPT and the Trails tests, and all Connors Rating Scale components.
Table 4 – Mean score on functional assessment by age group.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Young children (6-8 years)</th>
<th>Older Children (9-10 years)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Score (sd)</td>
<td>Mean Score (sd)</td>
<td></td>
</tr>
<tr>
<td>Tower of London</td>
<td>71.36 (14.36)</td>
<td>78.14 (12.90)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Colour Trails: I</td>
<td>36.90 (15.60)</td>
<td>22.95 (11.03)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Colour Trails: II</td>
<td>83.52 (32.88)</td>
<td>51.99 (22.78)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>MVPT</td>
<td>102.67 (18.58)</td>
<td>106.61 (15.54)</td>
<td>= 0.37</td>
</tr>
<tr>
<td>Connors Rating Scale (Oppositional)</td>
<td>55.28 (10.33)</td>
<td>50.42 (6.88)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Connors Rating Scale (Cog./Att.)</td>
<td>52.45 (9.57)</td>
<td>49.19 (7.05)</td>
<td>= 0.12</td>
</tr>
<tr>
<td>Connors Rating Scale (Hyperactivity)</td>
<td>55.58 (7.13)</td>
<td>51.89 (6.84)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Connors Rating Scale (ADHD)</td>
<td>54.53 (7.87)</td>
<td>51.62 (7.24)</td>
<td>= 0.13</td>
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</table>

TRAFFIC EXPOSURE – Parents provided information on traffic exposure and behaviour, particularly in terms of frequency and quality of supervised walking undertaken by their child (who supervised and whether they held their hand while crossing the road), and frequency of playing in the street. Figure 2 shows the frequency of walking unsupervised by age group. The majority of younger children never walked unsupervised, compared with older children. Older children were more likely to report occasionally or sometimes walking unsupervised, $\chi^2(4) = 8.10$, $p = 0.08$. 
Some other group differences with regard to amount of road crossing education were also noted. Older children were more likely to have been taught to cross at signalised crossings compared with younger children (100% vs 85%), $\chi^2(1) = 4.29$, $p < 0.05$. Older children were also more likely to not hold their parent’s hand while crossing, compared with younger children, $\chi^2(1) = 7.99$, $p < 0.01$.

![Figure 2 – Frequency of walking unsupervised by age group.](image)

Parents also provided information on level of traffic education, their attitude to traffic education and a rating of their child’s ability to cross the road safely. No group differences were noted here – almost all parents indicated that they had taught their children to cross where there are lights (younger children: 85%; older children: 100%), where crossing guards are present (younger children: 85%; older children, 85%), cross at zebra crossings (younger children: 74%; older children, 85%), and to look both ways before crossing (younger children, 100%; older children: 96%).

No significant group differences were found for ratings of a child’s ability to cross the road safely, however, parents of older children were more likely to rate their child’s ability as better than average, compared with parents of younger children (46% vs 20%). In comparison, parents of younger children were more likely to rate their child’s ability as about average, compared with parents of older children (65% vs 39%).
PREDICTORS OF CRITICALLY INCORRECT RESPONSES

Logistic regression modelling was used to examine the impacts of functional performance, traffic exposure factors and vehicle factors on the likelihood of making critically incorrect responses. Potential variables included: Tower of London raw score; Colour Trails I & II time (s); MVPT raw score; Connors Rating raw scores (all four components); independent travel exposure (high or low); and ratings of child’s ability to cross the road safely (significantly better than average, better than average, average, and worse than average). Continuous test scores were dichotomised, using the median as a division between the two groups of values for each variable and were classified as being high or low, for scores above or below the median, respectively.

The model resulted from these analyses is summarised in Table 5. This model indicates that vehicle factors, predicted responses, particularly time gap.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Wald Statistic</th>
<th>p-value</th>
<th>Rel. Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time gap</td>
<td>172.85</td>
<td>&lt; 0.001</td>
<td>0.25 (0.20, 0.31)</td>
</tr>
<tr>
<td>Vehicle speed</td>
<td>5.08</td>
<td>&lt; 0.05</td>
<td>1.01 (1.00, 1.02)</td>
</tr>
<tr>
<td>Tower of London score</td>
<td>14.24</td>
<td>&lt; 0.001</td>
<td>0.98 (0.96, 0.99)</td>
</tr>
<tr>
<td>Colour Trails II score</td>
<td>26.41</td>
<td>&lt; 0.001</td>
<td>1.01 (1.01, 1.02)</td>
</tr>
<tr>
<td>Connors Rating Scale (Hyperactivity)</td>
<td>2.64</td>
<td>= 0.10</td>
<td>1.06 (0.99, 1.14)</td>
</tr>
<tr>
<td>Independent travel</td>
<td>4.65</td>
<td>&lt; 0.05</td>
<td>2.36 (1.08, 5.16)</td>
</tr>
<tr>
<td>Supervised travel</td>
<td>2.65</td>
<td>= 0.10</td>
<td>0.76 (0.56, 1.06)</td>
</tr>
<tr>
<td>Ability to cross roads (significantly better than average)</td>
<td>3.80</td>
<td>= 0.05</td>
<td>3.82 (0.99, 14.72)</td>
</tr>
</tbody>
</table>

Not surprisingly, as time gap increased, the likelihood of a critically incorrect response decreased. Poor performance on tests of attentional, cognitive and executive functional performance was associated with a higher likelihood of critically incorrect responses. Two traffic exposure factors were also associated with the likelihood of critically incorrect responses. Children who seldomly walked independently were 2.4 times more likely than those who frequently walked independently to have made critically incorrect responses.
Furthermore, children whose road-crossing ability was rated by their parents as worse than average were 3.8 times more likely than those whose road crossing ability was rated as significantly higher than average to have made critically incorrect responses.

**DISCUSSION**

The broad aim of this study was to examine road-crossing decisions amongst young children with a view to better understand the separate component skills that comprise the road-crossing task and to identify ‘at risk’ children.

There is a large body of literature suggesting that young children are less competent in traffic, are generally inconsistent in their road safety behaviours and are easily distracted. The current findings generally support these contentions and have highlighted some additional factors that may be associated with poor road-crossing skill, including vehicle factors, young age, less well-developed attentional, cognitive and executive skills, and little unsupervised traffic exposure.

The results suggest that children primarily use distance rather than the speed of approaching vehicles when making judgement about safe crossing gaps. This was evidenced by the findings that children were more likely to make a ‘yes’ decision in longer distance gaps, despite the time gap being the same (see Figure 1). This finding is consistent in other studies with child pedestrians [Connelly et al., 1998; Simpson et al., 2003], older adult pedestrians [Oxley et al., 2005] and alcohol-affected pedestrians [Oxley et al., 2006]. This suggests an immediacy effect where a vehicle far away, irrespective of its travelling speed, is judged to be less threatening than one close up [Oxley et al., 2005]. The danger is, however, that if decisions are based purely on how far the vehicle is away, without consideration of its speed, a pedestrian may choose a gap that is not sufficiently long enough for safe travel. Indeed, for children, this may be especially dangerous, particularly if they are taught to only cross the road when the oncoming vehicle is far away.

Of particular interest in this study were the analyses of critically incorrect responses. The finding that more than half of all children made at least one critically incorrect decision, based on their fast walking time and time gap of the approaching vehicle was of particular concern. These children were generally younger. Indeed, age was a strong predictor of critically incorrect decision, with six year olds almost 12 times more likely than 10 year olds to make a critically incorrect decision.

Moreover, children who performed poorly on tests of functional performance displayed poor road-crossing skills. Making decisions about when it is safe to cross in relation to available gaps in the traffic is a complex task requiring accurate judgements of a vehicle’s time of arrival at the crossing point, distance and speed, as well as one’s own walking speed. This task implicates a range of perceptual, attentional, cognitive and executive functions. While previous research has examined
children’s behaviour in traffic and discussed behaviour in terms of performance limitations (often using the Piagetian models of children’s cognitive development) [e.g., Whitebread & Neilson, 2000; Sarkar, Kaschade & de Faria, 2003; Dunbar, Hill & Lewis, 2001; Tabibi & Pfeffer, 2003; Zeedyk et al., 2002], few have examined the specific functional skills that may impact on road-crossing decisions. The current study has highlighted that poor road-crossing skill may lie within higher order functions such as attentional, cognitive and executive skills. In the road-crossing context, these kinds of skills are likely to be important in tasks such as understanding and remembering traffic rules and signs, following directions, utilising executive functions, allocating attention, processing information quickly and accurately, and minimizing the effects of distraction.

In addition, much of the research on child pedestrian safety discusses the importance of exposure to traffic and acquiring skills in real-traffic environments [e.g., Zeedyk & Kelly, 2003], particularly developing an awareness of traffic and learning fundamental road safety practices, initially under adult supervision and leading to independent travel. The current findings suggest that exposure to traffic, particularly the amount of independent travel is associated with road-crossing skill. Children who walked independently more frequently were less likely to make incorrect crossing decisions compared with children who walked independently less frequently. This suggests that age-appropriate traffic exposure is beneficial for acquiring road skills.

It is possible the simulator environment may have produced gap selection judgements that may be different from those of children in normal traffic, which may limit the results of the study somewhat. As the participants did not need to cross an actual road there was no risk in making an erroneous decision. It has been suggested by Ebbesen et al. [1977, as cited in Connelly et al., 1998] that perceived risk affects decision making, so removal of risk may have affected the outcome in this study. Further, the results may be an artefact of the impoverished two-dimensional viewing conditions of the simulator. However, these effects are likely to be minimal, as a validation study by Oxley, Fildes, Ihsen and Charlton [1997] showed that crossing decisions and perceptions of safety by younger and older adults in real world and filmed versions of traffic scenes were highly correlated. This has yet to be validated in children, and is an area for future research. Further, the small sample sizes may have prevented detection of some important age group differences and risk factors. Nevertheless, the study has provided some interesting and valuable information on which to base countermeasures and further research.

These findings have potential to direct a number of initiatives for child pedestrian safety, including creating safe walking environments, improving driver awareness of child pedestrian behaviour and pedestrian protection in vehicle design. These findings also have direct implications
for education and training programs, and supervision for child pedestrians. Education has long been advocated as a means of teaching children the skills to be able to interact with traffic safely. Road safety education programs are common in pre-school and early primary years (pedestrian safety) and bicycle education programs in later primary and secondary years world-wide. However, there are some concerns as to their effectiveness. The major problems seem to lie with the assumption that, if children were provided with information, their knowledge about road safety would automatically increase. This may not be the case, especially for younger children [Ampofo-Boateng & Thomson, 1991; Zeedyk et al., 2001]. Moreover, education may produce negative effects in that the increased knowledge that children exhibit can create a false sense of confidence amongst parents and children that their ability to face the road environment is improving [Zeedyk & Wallace, 2003]. Others argue that training programs are only moderately successful because they treat each child the same, and should be specifically tailored for and allocated to those who are most in need of training.

The findings of the current study suggest that there are, indeed, specific behaviours, functional limitations, travel patterns and behaviour in traffic environments that may put some children at increased risk of a pedestrian collision. This information has provided a better understanding of the separate component skills that comprise the road-crossing task and has identified ‘at risk’ children. It has been instrumental in the development of a targeted, practical training program which is aimed at improving essential skills and strategies to cross roads safely amongst ‘at risk’ children through the provision of extensive feedback regarding road-crossing decisions in critical time gaps and with a range of distracting factors. An evaluation of the benefits of the training program is currently underway and preliminary analyses suggest a beneficial effect of the program in reducing the number of critically incorrect responses amongst 6-10 year old children.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study confirmed some previous findings related to child pedestrian road-crossing behaviour and identified a number of factors associated with poor road-crossing skill. The findings that poor attentional, cognitive and executive skills as well as younger age and low independent traffic exposure were related to poor gap selection have enhanced our understanding of which children are at increased risk. This information is a valuable resource on which a range of safety initiatives can be based, including environmental and vehicle improvements, but particularly a targeted and practical educational and training program aimed at teaching good road-crossing skills amongst ‘at risk’ young children. A training program has been developed and is currently being evaluated.
ACKNOWLEDGEMENT:
This project was funded by the NRMA-ACT Road Safety Trust (Australia).

REFERENCES


