ADULT PEDESTRIAN BEHAVIOUR WHEN ACCOMPANYING CHILDREN ON THE ROUTE TO SCHOOL

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ABSTRACT

***Objective*:** Pedestrian injuries are a major cause of morbidity and mortality to children, especially boys. Adults serve as pedestrian role models and provide learning opportunities to children when walking to school. The research objectives were to investigate adult pedestrian behaviour when accompanying boys and girls.

Methods: Behavioural observation of 140 adult pedestrians accompanying 4 – 9 year-old children was done in British residential locations. Observations took place at light-controlled crossings, speed restricted school safety zones and mid-block unmarked crossing sites. Behaviours observed included stopping at the curb, waiting at the curb, looking left and right before and during road crossing, holding hands, talking, and walking straight across.

***Results*:** In general, adults modeled safe road crossing behaviours. Adult safe behaviour scores were higher when accompanying girls than when accompanying boys. No statistically significant differences were found by child age group. The fewest safe pedestrian behaviors were observed at light-controlled crossings.

Conclusions: Adult pedestrians behave differently when with boys and girls and at different types of road crossing site. Interventions aimed at reducing pedestrian injuries to children may need to take these different everyday experiences into consideration.

INTRODUCTION

Road traffic injuries are a leading cause of death and disability to children (Peden et al. 2004, 2008). Boys are more at risk of death and serious injury than girls (Peden et al. 2008; Roberts 1996; Towner et al. 2005) and children in the 5 – 9 years range have four times as many pedestrian casualties as adults (Thomson 1996).

For young children, experiences of road traffic are often in the company of adults. Adults, especially parents, play an important role in supervising children to keep them safe and in teaching children pedestrian skills (Morrongiello 2005; Thomson et al. 1998). Most importantly, adults provide opportunities for children to learn everyday behaviors, such as road crossing, in context. This is an important means of developing skills, according to Vygotskian theory of child development (Vygotsky 1978) and Bandura's social cognitive theory (Bandura 1986). From a Vygotskian perspective, children learn everyday tasks, such as pedestrian behaviors, by observing and by doing, in collaboration with adults who possess more appropriate skills than children (Rogoff 1990). From a social cognitive theory perspective (Bandura 1986), children learn by observing the behaviours of other people. Parents and other adults provide models of pedestrian behavior for children to observe. Such modeling is an important means of learning appropriate behavior (Bandura 1986) and is a more prevalent means of learning road crossing behavior than direct teaching.

Research on children's pedestrian behaviours has steadily increased (e.g., Barton and Schwebel 2007b; Dunbar et al. 2002; Rosenbloom et al. 2008; Stavrinos et al. 2009; Zeedyk et al. 2002). However, relatively few studies have investigated the pedestrian behavior of adults when accompanying children (Morrengiello and Barton 2009). Adults have been found to model safe road crossing behavior to children but not use the road crossing activity as an opportunity to explicitly teach children about road safety (Morrongiello and Barton 2009; Zeedyk and Kelly 2003). Also, adults may behave differently when accompanying boys and girls depending on social and cultural context. British studies have found that adults were more likely to hold a girl's hand when crossing the road and that parents controlled girls more than boys (Dunbar et al. 2002; Zeedyk and Kelly 2003). In Canada, parents were more likely to model safe crossing behavior for boys than girls (Morrongiello and Barton 2009). Our first

research objective was to add to the sparse research literature on adult pedestrian behaviors when accompanying boys and girls.

There are marked age differences in children's pedestrian abilities. Between 5 and 9 years children have a high risk of pedestrian injuries, have limited pedestrian capabilities and take more risks when crossing a road (Assailly 1997; Barton and Schwebel 2007a, 2007b; Sandels 1977; Thomson 1996). Pedestrian skills gradually improve as children mature (Whitebread and Neilson 2000). Also, adult supervision decreases as children grow older (Wills et al. 1997). Given these findings, it should be expected that adults' road crossing behaviors will differ according to the age of the child. Observational studies of adults accompanying child pedestrians have found inconsistent results for the effects of child age. For example, Zeedyk and Kelly (2003) found that adults' road crossing behavior did not differ according to the age of the child, whereas Dunbar et al. (2002) found that it did. The second research objective was to compare adult pedestrian behavior by child age group.

Different types of pedestrian environments present different types of risk and different injury rates. The majority of child traffic injuries occur at mid-block locations, at intersections and near to marked crossing sites (Agran et al. 1994). Previous research of adult and child pedestrians has focussed on behavior at marked crossing sites, such as light controlled crossings (e.g., MacGregor et al. 1999; Zeedyk and Kelly 2003). The third objective was to expand the range of crossing sites observed and to examine the role of type of crossing site on pedestrian behavior.

Although men and women self-report different risk perceptions for pedestrian behaviors (Holland and Hill 2007), observations of the road crossing behavior of men and women have found few differences. For example, Yagil (2000) found that men are more likely to cross than women when a 'Don't Cross' signal is displayed, but found no differences in other behaviours such as looking. Observational studies of men and women when accompanying children have found no differences in pedestrian behavior (e.g., Zeedyk and Kelly 2003). The fourth objective was to further explore gender differences in adult pedestrian behavior.

METHOD

The research method used was behavioral observation. This provides ecologically valid information about everyday road crossing practices and modeling of behavior that is difficult to obtain through other methods. We observed the road crossing behaviors of adults accompanying children on the route to school, an everyday pedestrian activity for many children. Also, ecological studies of children's road traffic injuries have identified locations with schools as having high rates of injury due to regular, often congested traffic patterns (LaScala et al. 2004).

Participants

One hundred forty adult pedestrians accompanying children were observed. The behaviors of adults accompanied by two or more children were not coded. This was to provide a basis for comparison that would be consistent with previous research (e.g., Zeedyk & Kelly 2003) and to standardise and simplify live observations. Data was coded for all adult-child pairs who crossed the road during the set observation period. A total of 102 (72.9%) of the adult pedestrians were female and 38 (27.1%) were male; this unequal ratio of adult males to females is typical of British child care arrangements. Sex of child pedestrians was evenly distributed; 70 of the child pedestrians were female and 70 were male. Seventy nine (56.4%) of the child pedestrians were between 4 and 6 years and 61 (43.6%) between 7 and 9 years.

Locations

Three types of pedestrian crossing sites were observed. These were light-controlled ("pelican" crossing), school safety zone, straight road with no identified crossing facilities ("midblock"). Crossing sites were located in residential areas on well-used pedestrian routes to school. Observations were made at two pelican crossings; both extending over two lanes with no pedestrian refuge in the middle. The second type of site was a school safety zone consisting of speed restrictions, yellow warning markings on the road extending to either side of the crossing point and a designated crossing point identified by yellow markings and the words "Look both ways" painted on the road surface. The third type of site, straight road with no identified crossing facilities, was the most common type of site available. Two different sites were used, both were mid-block. The average waiting times were 34.03 seconds at the light

controlled crossings, 30.90 seconds at the school safety zone and 72.89 seconds at the straight road with no identified crossing facilities. A total of 45 adult-child pairs were observed at the pelican crossings, 40 adult-child pairs at the school safety zone and 55 adult-child pairs at sites with no identified crossing facilities. This was 35 per cent of pedestrians crossing at these sites within the specified age range. The remaining pedestrians were sole adults crossing with more than one child (36%), more than one adult crossing with one or more children (19%) and groups of children crossing together (10%).

Procedure

The research was approved by the University of Lincoln Faculty Ethics Committee. Data collection was carried out over a 6-week period in dry weather conditions between 8.40 and 9.15 a.m. and 3.00 to 3.35 p.m. (school opening and closing times). All observations were done live, not video-recorded, in order to protect the privacy and anonymity of participants. Observations were done by two observers unobtrusively with the observers positioned so that they had a clear view of the road crossing site. One observer coded adult behaviour and one coded child behaviour. An observational checklist was used to obtain a frequency count of the behaviours listed in Table 1.

Behaviour Categories and Scoring Procedure

Pedestrian behaviors (see Table 1) were selected from those used in previous observation studies conducted in urban areas at light-controlled pedestrian crossings (MacGregor et al., 1999; Zeedyk & Kelly, 2003).

A total safe behaviour score was calculated for adults as follows. One point was awarded for of the following behaviours: stopping at the curb, waiting at the curb (30 seconds or more), looking both ways before crossing, looking both ways during crossing, holding the child's hand, walking across the road (not running), and walking straight across by the shortest route. The maximum possible score for each adult was 7 and the minimum possible score was 0.

Insert Table 1 about here

Prior to beginning data collection, the researchers observed behavior at the same locations in order to establish observer reliability. All discrepancies were discussed and

observations continued until observers reached agreement. This was done repeatedly until 100 per cent agreement was reached. Following Zeedyk and Kelly's (2003) procedure, children's ages were ascertained on the basis of their height, facial features and clothing (e.g., known differences in school uniform). Substantial pilot work was carried out to establish reliability by matching age coding with known ages of a sample of children. Observers reached 100 per cent agreement for the younger children (simplified by school uniform) and 90 per cent agreement for the older children. Discrepancies were discussed until observers reached agreement.

Data Analysis

Univariate analysis of variance was calculated to analyse the effects of sex of accompanied child (two levels), age group of accompanied child (two levels) and type of road crossing location (three levels) on adults' safe behavior scores. This also allowed the calculation of interactions between the three independent variables on adults' safe behavior scores. Levene's tests for equality of variance were conducted for each independent variable. All were statistically nonsignificant, indicating that the parametric assumptions for the use of analysis of variance (ANOVA) were not violated.

Because there were unequal numbers of adult men and women, comparison of the safe behavior scores of men and women required a matched sample of 38 women pedestrians. Matching was done on the basis of sex of child, child age and road crossing location. ANOVA was used to analyse the effects of sex of adult on safe crossing behaviors and interactions between adult sex, child sex and child age. Analyses of specific road-crossing behaviors were carried out using a series of chi-squared tests. We hypothesized that adults would display more safe pedestrian behavior when accompanying (1) girls and (2) younger children. We also hypothesized that adult pedestrian behavior would be affected by (3) type of road crossing facility and (4) adult gender.

RESULTS

Adult Road-Crossing Behaviors

Adult safe behavior scores when crossing the road were high; mean = 5.04, *SD* = 1.08 (maximum possible score = 7). Descriptive analysis of specific behaviors showed that the majority of adults stopped at the curb (94.3%, *n* = 132) and waited (89.3%, *n* = 125), looked left and right before crossing (76.4%, *n* = 107), and walked across the road (88.6%, *n* = 124) taking the most direct route (shortest distance) straight across the road (87.9%, *n* = 123). However, the majority of adults did not look left and right during road crossing (80.7%, *n* = 113) and did not hold the child's hand when crossing (52.9%, *n* = 74). In addition, the majority of adults did not speak to the child before crossing (60%, *n* = 84).

The Effects of Sex of Child on Adult Safe Road-Crossing Behaviors

Adult safe behavior scores were significantly higher when accompanying girls (mean = 5.21, *SD* = 1.03) than when accompanying boys (mean = 4.86, *SD* = 1.09), F (1, 128) = 5.25, $p < 0.03$ confidence interval (CI) 97%. This difference was evident at all three crossing sites and for both age groups (see Table II). There was no statistically significant interaction between the effects of sex of child and age of child or road crossing location on adult safe behavior scores.

Analysis of the frequencies of specific adult road-crossing behaviors by sex of accompanied child found statistically significant differences for hand-holding. Only 35.7% (*n* = 25) of adults held a boy's hand in comparison to 58.6% (*n* = 41) who held a girl's hand, $\chi^2(1) = 7.34$, $p = .007$. No other comparisons of specific crossing behaviors were statistically significant after Bonferroni corrections were applied.

Insert Table II about here

The Effects of Child Age on Adult Safe Road-Crossing Behaviors

The effect of child age on adult safe behavior scores was statistically nonsignificant, F (1, 128) = 0.80, $p > 0.05$ CI 95 per cent. Adults did not behave in a safer manner when accompanying younger or older children (see Table II). There was no statistically significant

interaction of child age and sex of child or road-crossing location on adult safe behavior scores; adult safe behavior scores were not affected by child age at any of the road-crossing facilities.

Analysis of the frequencies of specific road-crossing behaviours found no statistically significant differences for talking and looking behaviour when Bonferroni corrections were applied. Also, there was no statistically significant difference in the amount of adult and child hand-holding by age group.

The Effects Of Road Crossing Location On Adult Safe Road-Crossing Behaviors

Adult safe road-crossing behavior scores were affected by type of road-crossing site, F (2, 128) = 13.01, $p < 0.001$ CI = 99.9%. As can be seen from Table II, the highest safe behavior scores were observed at the 20 mph school safety zone and the lowest safe behavior scores were found at the pelican crossing. Post hoc Bonferroni tests showed statistically significant differences between all three road crossing sites ($p < 0.004$). There was no significant interaction between type of road crossing location, sex, or age of child on adult safe behavior scores.

Analysis of the frequencies of specific adult behaviors by crossing site found the following statitistically significant differences between crossing sites following Bonferroni corrections. Fewer adults looked left and right before crossing at the light-controlled crossing (35.5%) than at the school safety zone (97.5%) and the mid-block location (94.5%); $\chi^2(2) = 61.61$, $p <$ .001. Also, fewer walked straight across the road at the mid-block location (72.2%) than at the other two sties (100% at the school safety zone and 95.5% at the light-controlled crossing); $\chi^2(2) = 19.83$, $p < .001$.

Comparisons Between The Road-Crossing Behaviors Of Men And Women

In order to compare the safe behaviour scores of men and women, a series of two-way ANOVA tests were carried out on a matched sample (see Method section for matching criteria). No statistically significant effect of sex of adult was found and no interaction between sex of adult and sex of child (see Figure 1). However, there was a statistically significant interaction between sex of adult and child age; F (1, 72) = 4.96, $p < 0.03$ CI = 97%

(see Figure 2). Men displayed more safe behaviors when accompanying the older children and women displayed more safe behaviors when accompanying the younger children.

Analyses of specific road-crossing behaviors of men and women found no statistically significant differences. More children operated the light control at the pelican crossing when accompanied by a woman but this did not reach statistical significance ($p = 0.054$).

Insert Figure 1 and Figure 2 about here

Children's Road Crossing Behaviours

The majority of children did not press the button to operate the light controls at the pelican crossing (77.8%) and the majority of children did not look left and right before (92.9%) or during crossing (97.9%). There were no statistically significant differences in frequency of child safe behaviours by sex or age of child.

DISCUSSION

The results showed that the majority of adults modeled safe pedestrian behavior for important aspects of road crossing. These were stopping at the curb and waiting, looking to left and right *before* crossing and walking straight across the road taking the shortest route. The majority of adults did not look to left and right *during* road crossing and approximately half of the adults did not hold the child's hand when crossing. Road-crossing behavior varied depending on sex and age of accompanied child as well as type of road-crossing facility.

Adults behaved more cautiously when accompanying girls in comparison to boys, supporting previous research observations on British roads (Dunbar et al. 2002; Zeedyk & Kelly 2003). The overall mean safe behavior score was significantly higher when adults accompanied girls compared to boys. However, this difference in means was small (5.21 when accompanying girls compared to 4.86 when accompanying boys), and the direction of difference was consistent was consistent across all crossing sites. Considering specific behaviors, adults were more likely to hold hands with girls than boys. This supports Zeedyk and Kelly's (2003) findings and shows consistency in behavior across different types of pedestrian sites. In this respect sex of the child was a more influential factor than age of child. Zeedyk and Kelly suggested that adults perceive girls as being more in need of protection and control than boys. Another possible explanation is that boys are less likely to accept holding hands with adults in full view of other children in case this results in a loss of status among their classmates. Thomson (1996) commented that the marked difference in pedestrian injury rates for boys and girls has yet to be convincingly explained. The reason for such differences in unintentional injury rates is unlikely to be as simple as whether or not to hold hands when crossing the road. However, the consistency of this finding suggests that it is worth further investigation.

In general, there was no difference in the amount of safe pedestrian behavior by child age group, supporting Zeedyk and Kelly's (2003) findings.

Adult pedestrian behavior was affected by type of site. The highest safe behavior scores were obtained at the 20 mph safety zone. This type of crossing facility serves two purposes. It provides a warning to drivers and it provides reminders to pedestrians which may serve to increase their safe pedestrian behaviors. The implications of this finding are that pedestrian

behavior varies according to type of site. The lowest safe behavior scores were observed at the pelican crossing. Pelican crossings increase pedestrian safety by forcing drivers to stop. However, they may decrease pedestrian looking behavior and waiting at the curb as pedestrians may rush to cross when the lights are about to change against them. Differences in site-specific behaviors should be expected (such as crossing the button to display the green man). However, the differences observed in this study were in more general road crossing behaviors such as looking behavior and walking straight across the road. These differences were consistent across sex of adult, sex of child, and age of child.

Although the main effect of adult gender on pedestrian behavior was statistically nonsignificant, there was a significant interaction with child age. Men displayed more safe behaviors when accompanying older children and women displayed more safe behaviors when accompanying younger children. This difference was in number of behaviors rather than type; there was no difference in any specific type of road crossing behavior observed. Most research on the child safety-related behaviors of men has been on fathers of pre-school aged children (e.g., Morrongiello and Dawber 1999; Schwebel and Brezausek 2007). The results of this study provide information about safety-related behaviors of men in relation to school-aged children.

Observations in a range of traffic environments provide information about behavior that is difficult to obtain indirectly through other methods such as interviews and questionnaires. Observation provides a measure of what pedestrians actually do rather than what they say they do. However, there were several limitations. Observers were unobtrusive but not hidden. This may have affected pedestrian behavior. No assumptions were made about whether adults were instructing children in road-crossing behaviors or discussing more general topics. Also, the focus was on adults accompanying one child to increase reliability and comparability with previous research. However, this may limit the generalizability of the results. Adult behavior may differ when accompanying more than one child, and when accompanying children of different ages. We chose observation sites and times that would be comparable with previous research and that are associated with relatively high traffic flow. Because child pedestrians have high injury rates at other locations (Posner et al. 2002), further research is needed on pedestrian behaviour in residential and play areas. To counterbalance these

limitations, the main strength of the research lies in providing useful information about children's pedestrian learning opportunities that would be impossible to obtain using any other method.

In conclusion, this study has shown that adults generally model safe crossing behaviour when crossing the road with a child. However, few children independently performed the safe pedestrian behaviors modeled. This supports Zeedyk and Kelly's (2003) observations. Contrary to social cognitive theory expectations, indirect learning of safe pedestrian behaviors was not demonstrated. However, for children to imitate the safe behaviors modeled by accompanying adults, they first of all need to pay attention (or have their attention drawn) to these behaviors. Implications of the results for child pedestrian interventions aimed at reducing injuries should focus on encouraging parents to teach road crossing skills to children directly and to draw children's attention to the safe behaviors being modeled. Parents and carers can be effective road safety educators for children (Thomson et al., 1998). They also have more frequent opportunities to teach road safety skills than professional road safety educators. Further research is needed on the most effective ways of supporting parents in this regard. Also adults behaved differently when accompanying boys and girls at a range of road-crossing sites and the rate of safe road crossing behaviors varied with the type of road-crossing facility. Interventions aimed at reducing pedestrian injuries to children should take these differences into consideration.

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Table 1

Adult and child road-crossing behaviors observed

Adult road-crossing behaviors	**Child behaviors**
Stop at curb*	
Wait at curb*	
Adult talks to child	
Adult looks left & right before crossing (inferred from head movements)*	Child looks left & right before crossing (inferred from head movements)
Adult looks left and right during crossing (inferred from head movements)*	Child looks left and right duringcrossing (inferred from head movements)
Adult holds the child's hand*	
Walk across the road (not run)*	Walk across the road (not run)
Walked straight across (took the shortest route across)*	
Adult presses button to control light at pelican crossing	Child presses button to control light at pelican crossing

*Component of total safe behavior score

Table 2

Adult safe behavior scores when accompanying boys and girls from two age groups at three types of road crossing location (maximum possible score = 7)

		Adults with boys			Adults with girls			Overall adult scores for each crossing site
		4-6 yrs	7-9 yrs	All boys	4-6 yrs	7-9 yrs	All girls	
Light	Mean	4.46	4.20	4.35	4.35	5.00	4.50	4.42
Controlled	SD	0.66	1.14	0.86	0.86	0.71	0.86	0.86
Crossing	*n*	13	10	23	17	5	22	45
School	Mean	5.47	5.50	5.48	6.09	5.75	5.95	5.70
safety zone	SD	0.87	1.00	0.87	0.70	0.46	0.62	0.79
	n	17	4	21	11	8	19	40
No	Mean	4.78	4.82	4.81	5.17	5.35	5.28	5.05
designated	SD	1.31	1.18	1.20	1.34	0.79	1.03	1.13
facilities	*n*	9	17	26	12	17	29	55
Overall adult	Mean	4.97	4.71	4.86	5.08	5.40	5.21	5.04
scores by	SD	1.01	1.19	1.09	1.21	1.21	1.03	1.08
child sex and	*n*	39	31	70	70	40	70	140
age								

Figure 1

Matched sample of adult mean safe behavior scores when accompanying boys and girls

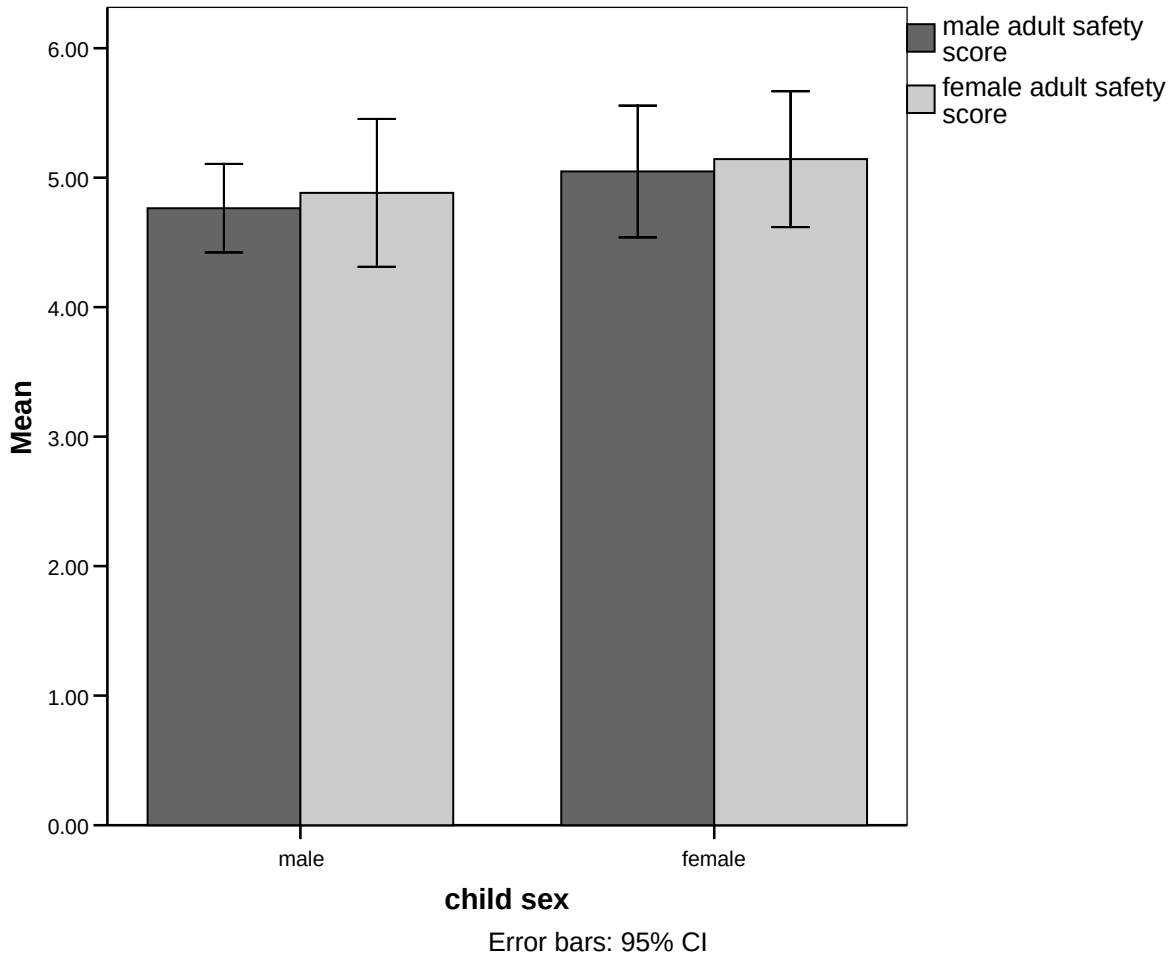

Figure 2

Matched sample of adult mean safe behavior scores when accompanying older and younger children