Brief Report: Increasing Children's Safe Pedestrian Behaviors through Simple Skills Training

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Objectives Hundreds of American children are killed and thousands more injured annually as pedestrians. Simple and effective interventions targeting behavioral changes in children are needed. **Methods** The present study tested a simple, skill-based training method for increasing safe pedestrian behaviors. Eighty-five children ages 5–8 participated. **Results** Children behaved more safely following training, indicating very brief training can produce at least short-term improvements in pedestrian behaviors. **Conclusions** Results are discussed with regard to the involvement of parents in the practical application of a simple training procedure and future directions for pedestrian interventions.

Key words injury prevention; pedestrian safety; training and intervention; unintentional injury.

Nearly 900 American children are killed annually as pedestrians, and an additional estimated 60,000 American children incur moderate to severe pedestrian injuries [National Center for Injury Prevention and Control (NCIPC), 2005]. A variety of pedestrian injury prevention techniques have been tested, but success from these programs has been mixed (Duperrex, Bunn, & Roberts, 2002).

Multiple risk factors contribute to pediatric pedestrian injuries. The physical environment is partly to blame (e.g., inexperienced or perceptually impaired drivers, poor traffic engineering, and high traffic volumes). Such factors are most often addressed by passive injury prevention techniques, such as traffic lights with pedestrian signals, crosswalks, speed bumps, and sidewalks (Retting, Ferguson, & McCartt, 2003). Along with environmental factors, behavioral factors also contribute to pediatric pedestrian injury risk (e.g., darting out between cars). Addressing this issue necessitates active, behaviorally oriented interventions (Duperrex et al., 2002). The most common method is through teaching and modeling, usually in combination with fairly extensive group lectures and/or behavioral reward systems (e.g., Demetre et al., 1993; Rivara, Booth, Bergman, Rogers, & Weiss, 1991; Rothengatter, 1984; Thomson et al., 1992; Young & Lee, 1987). These programs typically yield moderate short-term success, but they require intensive individual training by experienced educators.

Surprisingly, although parents serve as adequate models of safe pedestrian behaviors (Thomson et al., 1998; Zeedyk & Kelly, 2003), research suggests that parents do not typically use street crossings as an opportunity to involve children in safe pedestrian decisions. Parents tend to lead crossings, attend to traffic, and select traffic gaps and routes for crossing without discussing their behaviors (Zeedyk & Kelly, 2003). As a result, children pay little attention to safety cues when crossing with their parents and are given little opportunity to learn through supervised participation.

The present study tested a short, semi-structured intervention—one that could easily be replicated by parents—designed to teach 5- through 8-year-old children pedestrian safety skills without elaborate training routines or expensive equipment. The intervention targeted multiple basic pedestrian skills, including looking left and right, waiting for safe traffic gaps, and attending to environmental risk factors. Unlike previous interventions that have been tested, this intervention was simple and straightforward, easily delivered in a single brief session (<15 min), and offered

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in a safe street-side environment. We used a pre–post design to test the efficacy of the technique as a means of enacting short-term behavioral change.

Method

Participants

Eighty-five children, ages 5–8, were recruited from community advertisements and a laboratory database of families ($M = 7.21$ years, $SD = 1.25$). Children were 53% male, 53% Caucasian, 37% African-American, 4% Asian-American, and 6% other ethnicities. Seventeen five-year-olds, 20 six-year-olds, 16 seven-year-olds, and 32 eight-year-olds participated. Median annual household income was $60,000, ranging from <$20,000 to >$100,000.

Informed consent was obtained from parents and informed assent from children (as developmentally appropriate). Families received modest compensation for their time. The university's institutional review board approved all procedures.

Procedure

Street Crossing Task

The pretend road technique was used to measure children's pedestrian behaviors (Lee, Young, & McLaughlin, 1984). A wooden pretend crosswalk was constructed to replicate a nearby real crosswalk and was placed in a grassy area perpendicular to a two-lane, bi-directional road in a suburban neighborhood. The pretend road area was separated from real traffic using sawhorses and yellow "caution" tape. Participants stood on a wooden curb facing the real road and used real traffic to decide when to cross the pretend one. Anecdotal evidence from this study and previous empirical evidence (Lee et al., 1984) suggest that children understood the protocol well. Previous work also offers convergent validity with other pedestrian safety measures (Demetre et al., 1992; Lee et al., 1984; Young & Lee, 1987).

The real crosswalk connected a public library and school and was frequently used by unsupervised children. The posted speed limit was 30 miles per hour (mph), with traffic generally traveling 25–35 mph. Traffic was not controlled at the crosswalk but was regulated by lights within a half mile in both directions. Real and pretend roads were 30 feet wide. Average traffic volume during participants' sessions was 11.13 vehicles/min ($SD = 2.30$), a level associated with relatively high risk for pedestrian injury (Roberts, Norton, Jackson, Dunn, & Hassall, 1995).

The Intervention

Children received pedestrian skills instruction immediately followed by three practice crossings with a researcher on the pretend road. Practice crossings lasted 5–15 min. Researchers, who had no specialized training, followed a protocol emphasizing the following skills: (a) looking left then right several times before crossing; (b) waiting for safe crossing gaps to occur; (c) walking, not running across the street; (d) attending to traffic entering the roadway from both directions; and (e) noting features impeding the view of oncoming traffic (e.g., bushes, parked vehicles, curves, or hills in the roadway). Children were allowed to lead crossings and were encouraged to indicate safe crossing opportunities themselves, but researchers provided corrective feedback by preventing children from initiating unsafe crossings (e.g., crossing without looking left and right). Children were encouraged to actively participate in training (Thomson et al., 2005) by discussing safety cues and how to determine safety. Altogether, the training was designed to represent what parents could easily complete with their children by emphasizing basic skills for a safe pedestrian crossing and providing an opportunity to practice these skills under adult supervision.

Protocol

As part of a larger study of parent supervision,[1] children crossed the pretend road five times each under four intensities of supervision (20 crossings), ranging from no supervision to parent and child crossing together [see Barton and Schwebel (2006) for details]. Children stood on the pretend curb and began looking at traffic on the real road following a cue to "cross when you think it looks clear." Children crossed the pretend road when it appeared safe to cross on the real road. The researcher retrieved the child from the far curb and the process was repeated. All behaviors were videotaped from directly behind the participants. Children's five unsupervised crossings were of interest, as these crossings represented children's independent abilities, without parental influence. Following the 20 crossings, children completed the intervention training session. Five independent, unsupervised crossings were completed as a post-training evaluation.

[1]Findings in this manuscript come from a larger data set studying the role of parental supervision and child individual differences on child pedestrian safety. Other manuscripts using the same data set are currently under review for publication.

Behavioral Measures

Five pedestrian behaviors were measured during each crossing, excepting those completed during training: wait time, attention to traffic, missed opportunities, gap size, and tight fits. Aggregate scores for each measure were calculated for each child for the five pre-training and five post-training crossings by averaging measures of time and common events (wait time, attention to traffic, gap size) and summing uncommon events (missed opportunities, tight fits).

Wait time was calculated as the time in seconds that elapsed between researchers' cues to cross when judged safe and both of the participants' feet leaving the curb. *Attention to traffic* was measured as the number of times participants looked left plus the number of times they looked right for oncoming traffic while waiting to cross. Variations in traffic flow were controlled both for wait time and attention to traffic by dividing scores by traffic volume during the participant's session. Traffic gaps not chosen, that were >1.5 times the participant's average cross time, were considered *missed opportunities*. Due to high positive skew of this variable, data were recoded as 0 (no missed opportunities) or 1 (missed one or more opportunities to cross in a condition). *Gap sizes* were calculated as the interval, in seconds, between moving vehicles that participants chose to cross within. Paralleling previous pretend road research (e.g., Demetre et al., 1992), *tight fits* were tallied by counting the number of crossings a participant made in a gap that was temporally smaller than the average crossing time within that condition. Finally, a composite pedestrian safety measure was created by standardizing each measure across pre- and post-training conditions and then averaging the measures within condition to create an aggregate (the tight fits measure was reversed).

Removal of Outliers and Interrater Reliability

Within each pedestrian behavior, data were used from 10 trials across 85 participants for a total of 850 data points. Because children occasionally became inattentive while waiting to cross the street, scores more than three standard deviations from the mean were classified as extreme and removed. For all variables, these criteria affected only scores above the mean (scores more than three standard deviations below the mean were all negative numbers and could not appear), and no more than 3% (26 cells) of the data points within each variable were removed. Following removal of outliers, the five trials in each condition were aggregated into single measures of pedestrian safety, by condition (pre-training vs. post-training). To establish reliability in coding, two researchers independently coded behaviors for 20% of the sample. Reliability for all measures was high, ranging from $r = .97$ to $r = .99$.

Results

Descriptive statistics were examined first (Table I). A series of ANOVAs examined whether the order of presentation of the five unsupervised crossings within the 20 pre-intervention trials related to differences found post-training, and no significant differences emerged. That is, unsupervised pre-training behaviors did not differ between children who first crossed alone and those who first completed supervised crossings.

Children's behavior during independent pre-training crossings was compared with independent post-training crossings in a repeated-measures MANOVA, with gender and age (5–6 vs. 7–8) entered as between-subjects factors. A significant multivariate main effect was found for training, $F(5, 68) = 4.65$, $p < .01$, Wilks' $\lambda = .75$, $\eta^2 = .26$. Univariate follow-up tests indicated significant post-training changes in four of the five measured behaviors (Table I). Following training, children waited longer before crossing, attended more to traffic, and chose larger gaps in traffic. Children also had fewer tight fits while crossing post-training.

Main effects for gender, $F(5, 68) = 3.02$, $p < .05$, Wilks' $\lambda = .82$, $\eta^2 = .18$, and age, $F(5, 68) = 3.31$,

Table I. *Means (SDs), F results, and pre-training correlations for pedestrian behaviors* ($N = 85$)

Pedestrian behaviors	Pre-training	Post-training	F	η^2	1	2	3	4	5	6
1. Wait time (seconds)	1.68 (1.29)	2.02 (1.50)	7.28**	.09	**.41****	.91**	.61**	.38**	−.34**	.83**
2. Attention to traffic (avg. number looks)	0.30 (.21)	0.35 (.20)	7.85**	.10		**.46****	.58**	.43**	−.37**	.84**
3. Missed opportunities (mean number)	0.62 (.49)	0.64 (.48)	3.50	.05			**.19**	.33**	−.49**	.78**
4. Gap size (seconds)	13.01 (4.55)	15.06 (4.51)	17.06**	.19				**.37****	−.59**	.71**
5. Tight fits (mean number)	1.17 (1.10)	.60 (0.89)	13.44**	.16					**.19**	−0.73**
6. Composite measure	−0.15 (0.77)	.14 (0.70)	13.16**	.14						**.43****

Bold-faced values designate pre- to post-training relations.

**$p < .01$.

$p < .01$, Wilks' $\lambda = .80$, $\eta^2 = .20$, also emerged, but no interactions with training were found. Girls and older children engaged in safer pedestrian behaviors. Girls ($M = 2.39$, $SD = 1.32$) waited longer before crossing than boys ($M = 1.43$, $SD = 0.91$), $F(1, 72) = 9.55$, $p < .01$. Older children ($M = 0.36$, $SD = 0.17$) attended more to traffic than younger children ($M = 0.28$, $SD = 0.19$), $F(1, 72) = 6.47$, $p < .01$, and had fewer tight fits ($M = 0.68$, 1.23; $SD = 0.68$, 0.92, respectively), $F(1, 72) = 9.99$, $p < .01$, but missed more opportunities to cross ($M = 0.72$, $SD = 0.34$) than younger children ($M = 0.53$, $SD = 0.39$), $F(1, 72) = 5.54$, $p < .05$.

As a final evaluation of the efficacy of the intervention, a repeated-measures ANOVA was used to compare pre- and post-training behaviors on the composite pedestrian safety measure. Gender and age were entered as between-subjects factors. Main effects were found for training, $F(1, 82) = 13.16$, $p < .01$, $\eta^2 = .14$; age, $F(1, 82) = 7.20$, $p < .01$, $\eta^2 = .08$; and gender, $F(1, 82) = 5.75$, $p < .05$, $\eta^2 = .07$. Older children ($M = 0.15$) and girls ($M = 0.13$) had higher scores than younger children ($M = -0.19$) and boys ($M = -0.17$). An age by training interaction also emerged, $F(1, 82) = 5.78$, $p < .05$, $\eta^2 = .07$, and suggested that younger children improved their pedestrian safety skills somewhat more as a result of the intervention more than older ones.

Discussion

This study tested a simple, skill-based training method for increasing safe child-pedestrian behaviors. Children behaved more safely following training, indicating immediate effectiveness of the brief training paradigm. Age and gender differences also emerged.

The success of the simple skills training method suggests that parents, teachers, or other adults might be able to train children in safe pedestrian skills effectively, efficiently, and without complex or intensive instructional techniques. Surprisingly, most parents do not use available opportunities to train their children in safe behaviors. In one report, adults were unobtrusively and unknowingly observed while they crossed streets with children, ages 5–10, at four locations in Dundee, Scotland (Zeedyk & Kelly, 2003). Although parents generally modeled safe behavior (e.g., they stopped at the curb and waited for a walk signal before directing children to cross), adults actually spoke to their children before or during only 6% of observed adult–child paired crossings. The observational methodology did not permit the researchers to overhear conversations, but the fact that just 6% of pairs included conversational exchange suggests that even fewer than 6% of adults were instructing children in safe street-crossing. This supposition is supported by findings that not a single child was observed attending to traffic, just 23% of the children pushed the walk signal button, and 50% of the children had to run to keep up with adults' rapid walking pace.

In this study, children were exposed to <15 min of pedestrian safety training in which they were expected to apply the knowledge communicated in the intervention. As was found in much more extensive training sessions (12–15 sessions per child; practice on both one-way and bi-directional streets) used by Young and Lee (1987), children exposed to our short, simple intervention showed safer behaviors at a statistically significant level on four of the five individual measures and the composite. These results show promise for the efficacy of very basic training to reduce what is among the leading causes of mortality in middle childhood. Parents, teachers, and other adults could routinely replicate this intervention as they cross streets, parking lots, and even driveways with their children. The practical challenge for parents (and scientists) is to increase children's active participation in street crossings when such opportunities are available. In particular, it will be important for researchers to explore ways to effectively motivate parents to teach children pedestrian safety skills in a manner similar to that tested in this intervention.

Our intervention failed to change just one measure of pedestrian safety, missed opportunities to cross. Unlike other variables, missed opportunities present no direct danger to children (Pitcairn & Edlmann, 2000). In other work, we have demonstrated that the rate of missed opportunities appears to increase through middle childhood (Barton & Schwebel, 2006), perhaps because a decrease in missed opportunities does not occur until the child develops a combination of adult-level cognitive–perceptual skills in pedestrian situations and the confidence that those skills will protect one's safety. During early childhood, the rate of missed opportunities may also reflect, to some degree, impulse control: children with better impulse control, and in particular those children who are still unsure of their cognitive–perceptual skills, may wait longer before crossing—and in these cases, missed opportunities reflect safe behaviors rather than dangerous or undesirable ones.

At least one other empirical study found little reduction in missed opportunities following training in pedestrian safety (Young & Lee, 1987). Taken together, the findings suggest: a reduction in missed opportunities may be among the last pedestrian behaviors to change developmentally; missed opportunities may reflect a combination of cognitive, perceptual, and impulse control traits; and the success of pediatric pedestrian safety interventions might be better gauged through measures such as attention to traffic and gap size selected rather than missed opportunities to cross.

Limitations and Future Directions

Several limitations of the present research should be mentioned. First, because this study was embedded in a larger research project, children completed a total of 20 crossing trials prior to training. Only five of those were unsupervised and are reported at present. The remaining 15 trials occurred in a randomized order and under varying levels of parental supervision. Together, the 20 trials completed prior to training may have functioned as an extended practice session on the pretend road, allowing children to exercise existing pedestrian skills. Although no corrective feedback was given, practice trials may have affected children's responses to training.

A second limitation of the present study is the study design, and specifically the lack of a control group. Because all children were exposed to several practice trials, including some supervised by parents, it is conceivable that extraneous factors contributed to the learning we observed. A third limitation is that long-term results are not available. Whether the reported results might have persisted over the course of days or months following training is unknown. A fourth limitation is the range of income levels represented in the sample. Pedestrian injuries are most frequent among children from lower income families (Laflamme & Diderichsen, 2000), who should be specifically targeted in future training efforts. Finally, it is unclear whether changes in participants' behavior following simple skills training would generalize from the pretend road setting to real road crossings. Future research examining a simple-skills method could consider assessment of actual road crossings along with simulated crossings.

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