



Using Theory to Guide Practice in Children's Pedestrian Safety Education

Donna Cross, Margaret Hall, and Peter Howat

ABSTRACT

Few pedestrian injury prevention programs appear to articulate the theory upon which their design and evaluation are based. This article describes how theory was used to plan, develop, implement, and evaluate the educational component of a comprehensive child pedestrian intervention. Organizational and planning theories were used to guide the conceptual development, implementation, and evaluation of the program, while behavioral and child development theories were used to identify the content and strategies to address the pedestrian behavior of seven to nine year old children. The resultant program demonstrated improved road crossing and playing behaviors in the intervention group children compared to those in the comparison group. The systematic use of relevant theory in this program is likely to be associated with its positive impact on children's pedestrian safety.

INTRODUCTION

In Australia, pedestrian injury is the leading cause of death among five to nine year old children (Australian Institute of Health and Welfare, 2002). In 1995, the pedestrian fatality rate for Western Australian children of this age (3.1/100,000 persons) was more than double that for Australia as a whole (1.3/100,000 persons) (National Injury Surveillance Unit, 1997). Moreover, for the decade prior to this research, there was no significant reduction in mortality rates from child pedestrian injury (Australian Bureau of Statistics, 1989).

The Child Pedestrian Injury Prevention Project (CPIPP) was one of the first major intervention research projects to evaluate the impact of a comprehensive education program and road environment changes on seven to nine year old's pedestrian safety knowledge, road crossing and playing behavior (Cross et al., 2000). This quasi-experimental trial involved a cohort of 1,603 children, followed from age seven to nine, their parents, and teachers. The program comprised a variety of educational and environmental interventions whose

development was informed by epidemiological, empirical, and theoretical evidence.

The CPIPP was conducted in three Perth, Western Australian metropolitan communities from 1995 to 1997. Two of these communities received an intervention, and the third acted as a comparison community. One community received an intervention comprising a school- and home-based pedestrian safety program and a community education and road environment intervention. The community/environmental intervention involved establishment of a community road safety committee which advocated for traffic management strategies, changes to speed limits around schools, development of traffic calming features in local streets, and establishment of "Safer-Routes-to-School" programs. Further details of the environmental intervention are reported elsewhere (Stevenson, Iredell, Howat, Cross & Hall, 1999). The other intervention community received the same school- and home-based pedestrian education program, but no community or environmental intervention. The comparison community re-

ceived the "usual" school road safety program.

In each of the three study years, the school- and home-based intervention comprised nine 40-minute pedestrian safety lessons and nine home activities. Teachers were asked to implement these lessons and send home the corresponding family activities in three clusters of three, 40-minute lessons at the beginning of the first three school terms. The key focus of the home and classroom activities was pedestrian skills training in a "real" road environment using

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school access and local traffic roads. All strategies were designed to be learner-centered, interactive, and to actively involve parents. The educational materials were presented within a cross-curricular format with applications in science, language, art, math, and physical education. To maximize teacher implementation, a half-day training to familiarize participants with the materials was conducted at the beginning of each of the three years. Teachers also received passive (user initiated) post-training support via telephone and facsimile. Students' families were actively engaged in the program through home activities linked to classroom lessons, school newsletters, fact sheets, and safety cues to action such as refrigerator magnets, note pads, and pens with pedestrian safety messages.

The Child Pedestrian Injury Prevention Project was one of the first school- and community-based programs to show it may be possible to de-accelerate the natural increase of pedestrian-related risk taking behavior in children (Cross et al., 2000). The educational and environmental intervention was more comprehensive than most previously published, and it is one of the first studies to validate self-report road-crossing behaviors in seven to nine year olds via observation and follow-up interview (Cross et al., 2000).

While the use of theory alone does not guarantee effective programs, it can increase the likelihood of success (Gielen & Girasek, 2001; Thompson, Sleet & Sacks, 2002). Gielen and Sleet (2003) note that with regard to injury behavior-change efforts:

“The limited success of behavior-change efforts in modifying injury-related behaviors can be traced, in part, to failure to fully understand the determinants of the behaviors and a failure to properly apply health behavior theory to the development and implementation of effective interventions.” (p. 66)

This article describes how multiple behavioral, interpersonal, child developmental, and organizational theories can be combined to influence the pedestrian behaviors of children. This process resulted in a com-

prehensive school-based intervention that was both multi-level and multi-component.

METHODS

Theoretical frameworks and models were used to guide each stage of the CPIP program planning process. A modified version of the PRECEDE/PROCEED (Green & Kreuter, 1991) model formed the organizing framework for the application of theory (Howat, Jones, Hall, Cross, & Stevenson, 1997). The six key stages used are shown in Figure 1.

Although this planning model was used to assess both behavioral and environmental risk factors for the Project, this article will discuss only the behavioral assessment.

Stage 1: Epidemiological assessment

The epidemiological factor assessment was based on a detailed descriptive study of 10 years of Western Australian child pedestrian injury data and the associated risk and protective factors (Stevenson, Lo, Laing, & Jamrozik, 1992). This assessment defined the primary target groups as seven to nine year old children, their teachers and parents, and also highlighted inadequacies in the current school-based road safety programs.

Stage 2: Behavioral and environmental assessment

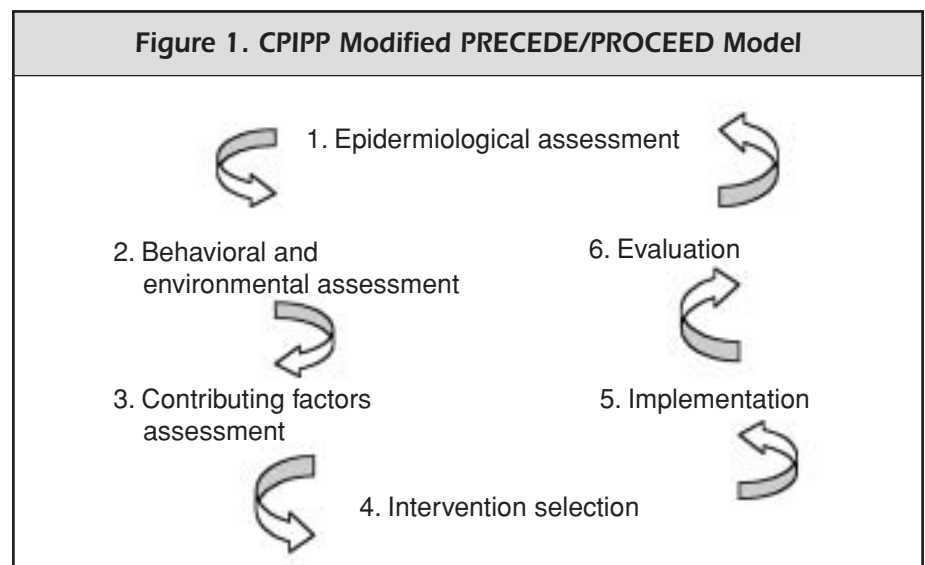
Data collected as part of a case-control study involving child pedestrians, ages one

to 14 years, identified four key environmental and behavioral factors that independently predicted the likelihood of child pedestrian injury. These included the volume of traffic encountered by the child during his or her exposure to the road environment, the presence of visual obstacles, footpaths on the child's street of residence, and importantly, the child's behavior (Stevenson, Jamrozik, & Spittle, 1995). Other evidence indicating the vulnerability of this age group included their lack of some essential cognitive and perceptual abilities to deal with traffic situations, such as poor search behavior, not choosing the safest places or seeking help to cross the roads, their small physical size, and their emotional immaturity (e.g., easily distracted)(Schieber & Thompson, 1996).

Stage 3: Contributing factors assessment

Predisposing factors contributing to these behavioral risk factors included children's and parents' lack of knowledge about safe road-crossing behavior and a perception of low risk of injury while crossing roads. Enabling factors included an inability to identify the safest road crossing sites, poorly developed road crossing skills, and in children, a lack of social confidence to ask trusted adults to help them cross. Two reinforcing factors were identified: parents allowing children to cross roads alone, and their perception that seven to

Figure 1. CPIP Modified PRECEDE/PROCEED Model



**Table 1. CPIP Health Promoting School Components**

Health Promoting School Model Components	CPIP Educational Intervention Activities
Formal Curriculum, Teaching and Learning	<ul style="list-style-type: none"> - Professional development to support classroom curriculum and whole-school policy and ethos - Provision of resources for road crossing skill building, utility knowledge, and attitude development
Organization, Policy and Ethos	<ul style="list-style-type: none"> - Administration and senior staff support for pedestrian safety - Review of the whole-school road safety policy - Monitoring and evaluation of pedestrian safety activities - Activities to promote awareness and implementation of school road safety policy
School, Home, and Community Links	<ul style="list-style-type: none"> - Communication of pedestrian safety policy and other information about pedestrian safety to the school community - Information about child pedestrian safety issues and strategies for parents in the school newsletters and at the school assembly - Information about parent mentoring and modeling of road crossing and other pedestrian behaviors in home activities - Links to local and state government road safety initiatives

nine year old children have adequate abilities to cross roads safely, unaccompanied (Howat et al., 1997).

Stage 4: Intervention selection

The multi-component Health Promoting School Model guided the extent to which schools, school staff, parents, and the local community were involved in the CPIP intervention (World Health Organization, 1996). School-based health initiatives which comprehensively target the physical and organizational environment of the school, including policy development and implementation, the classroom curriculum, and partnerships with parents and community organizations, are more likely to initiate and reinforce positive health behaviors effectively among students (Colquhoun et al., 1997). As shown in Table 1, the CPIP program was conceptualized us-

ing the three key Health Promoting School Model components.

Classroom education component

Theoretical models of how children learn and how this learning influences their health behavior were used to guide when and how children's pedestrian behavior change might be achieved. Social Cognitive Theory (SCT) (Bandura & Walters, 1963) and the Health Belief Model (Janz & Becker, 1984) were the behavioral models used to guide the intervention design. Table 2 summarizes the contribution of these theories and other child development theories to the development of the CPIP program.

The Health Belief Model (HBM) (Janz & Becker, 1984) variables were used to understand that the decision to take action to be a safer pedestrian will not be made unless the individual is psychologically

ready to take action, relative to the threat of injury or death and the perceived benefits. Readiness to act, in the context of the CPIP program, was defined by the extent to which children and their parents feel susceptible to pedestrian injury. As shown in Table 2, variables from the HBM were operationalized through program materials addressing the benefits of safe behaviors, children's vulnerability near roads, and development of self-efficacy as a skilled pedestrian.

Social Cognitive Theory suggests that a person's behavior is determined by factors such as capabilities to symbolize meanings of behavior, to foresee the outcomes of given behavior patterns, to learn by observing others, to self-determine behavior, and to reflect and analyze behavior (Bandura & Walters, 1963). The CPIP program used several educational techniques derived from this theory, including role modeling, observational learning, outcome expectancies, behavioral capability, and self-efficacy related strategies (for example, goal setting, skills training, and self-monitoring).

Theories related to children's maturational stages of development also informed the content and strategies used in the CPIP classroom educational intervention. Child development theorists (Gibson, 1979; Piaget & Inhelder, 1956; Vygotsky, 1962) suggest that learning occurs through development and adaptation of specific skills in specific contexts and the subsequent generalizations they make from these experiences (Thompson, 1996).

Consistent with these theories, the majority of the CPIP program's teaching and learning activity time (with teachers and parents) was directed toward opportunities for children to develop, practice, and reinforce specific pedestrian skills, in specific roadside contexts (simulated and real) that were relevant to the children's experiences. Gibson's Theory of Perceptual Motor Skills (Gibson, 1979), for example, provided strong justification for children to learn road-crossing skills at the roadside. This theory suggests that judgments and motor responses are best learned in the contexts



Table 2. Summary of Theories Used for the CPIP Classroom and Home Education Components

Key Components	Theory/ Model	CPIP Strategies Operationalized as Classroom and Home Activities Addressing:
Outcome expectancies, beliefs about benefits / costs of behavior, attitude to performing the behavior	Social Cognitive Theory (Bandura & Walters, 1963), Health Belief Model (Janz & Becker, 1984)	Why be safe near the road, children's vulnerability to injury
Normative expectations and social norms	Social Cognitive Theory	Problem solving, decision making activities
Self efficacy to performing behavior	Social Cognitive Theory, Health Belief Model	Pedestrian skill practice on real and simulated roads, planning for safer road crossing
Social modeling	Social Cognitive Theory	Pedestrian skill practice on real and simulated roads
Motor skill development	Theory of Proximal Development (Vygotsky, 1962), Theory of Perceptual Motor Skill Development (Gibson, 1979)	Pedestrian skill practice on real and simulated roads
Design of classroom strategies	Child Development Theory (Piaget & Inhelder, 1956)	Developmentally appropriate, learner centered, interactive, enjoyable activities

in which they occur, or close recreations of these. Contextual road crossing situations in CPIP schools included crossing at railroad crossings, guarded crossings, roundabouts, between parked cars, and exiting cars on the curbside.

Piaget's Theory (Piaget & Inhelder, 1956) assumes that children are active participants (rather than passive receivers of knowledge) in their intellectual development, who are continually trying to construct more advanced understandings of the world. This theory guided the redesign of the learner-centered, interactive activities and the inclusion of a range of activities to suit the different developmental levels and learning styles of children in the same grade level. The CPIP classroom education program comprised three developmentally appropriate curriculums, for each of Grades 2, 3 and 4 students, which cumulatively provided 27 hours of pedestrian skills training. The ac-

tivities addressed problem solving and the simulation and practice of pedestrian safety and road crossing behaviors.

Home education component

The home education component of CPIP aimed to increase parents' understanding of the developmental and behavioral characteristics of children under 10 years that increase their risk as pedestrians, and to provide parents with strategies to model and teach road crossing skills to their children (Rivara, Booth, Bergman, Rogers, & Weiss, 1991).

Home strategies targeting parents' readiness to take action to support their children in the road environment were also based on the Health Belief Model (Janz & Becker, 1984). The classroom-linked home activities, quarterly pedestrian safety newsletters, fact sheets, and educational cues (refrigerator magnet and notepads) were aimed to raise systematically parents' awareness of

their children's vulnerability. These strategies concurrently suggested the benefits and types of action parents could take to enhance their mentoring and modeling of appropriate pedestrian crossing behaviors with their children.

Other whole school educational components

Consistent with the Health Promoting School Model (World Health Organization, 1996), schools were encouraged to review their road safety policy and its implementation. Other whole school-based activities included liaison with road safety related community agencies and the schools' mapping and marking of safer walking routes for children to follow when walking to and from school.

Stage 5: Implementation

The Diffusion of Innovations Theory (Rogers, 1995) guided development of strategies to maximize teachers' and parents'



implementation of the classroom and home educational intervention. This theory is conceptualized as a staged process of adoption of a specific intervention among individuals or organizations over time (Rogers, 1995). For CPIPP, these stages included (1) schools and parents becoming aware of the CPIPP project; (2) deciding to adopt the program; (3) implementing the educational activities; and (4) if the implementation is successful, institutionalizing the program. While institutionalization is considered the final stage of the diffusion process during which innovations 'settle' into organizations (Steckler, Goodman, McLeroy, Davis, & Koch, 1992), the main focus of the CPIPP project was on stages 1 to 3 only of Diffusion Theory.

Rogers (1995) suggests that adoption and implementation of a new program is more likely to occur if it is perceived as better than the program it replaces, compatible with the values and needs of potential adopters, not complex to understand and/or use, provides an opportunity for trial before adoption, and has observable results. A number of strategies consistent with this theory were used in the CPIPP project to enhance and to measure the extent of its adoption. The formative research conducted during the development stage of the CPIPP intervention addressed teachers' needs for compatibility with their current teaching, reduced its complexity, and convinced them of its relative advantage. Use of extensive pilot and intervention teacher feedback meant the program materials were user-friendly (Cross et al., 1998).

A three-hour teacher training and follow-up meetings at schools gave teachers an opportunity to trial the program materials. The training addressed factors such as teacher expectations, availability of the support materials, and the linkage between the CPIPP materials and the statewide health education curriculum framework, teacher willingness to make changes to their current teaching, school support and reinforcement, and their sense of self-efficacy to implement the program. This information was used to demonstrate the relative advan-

tage of the CPIPP materials compared with other available resources and to model its ease of implementation.

Stage 6: Evaluation

The theories used to plan, develop, and implement the CPIPP program also provided guidance on the measures used to assess the impact of the program. The key behavioral outcomes measured as part of the CPIPP project included changes in the children's road crossing behavior, adult accompaniment of children in the road environment, and parents' self-efficacy.

The CPIPP evaluation, conducted after three years of intervention implementation, found a significant difference between the intervention and comparison groups for the two behaviors: crossing the road and playing on or near the road. Students in the intervention group were significantly more likely than comparison students to report (validated through observation) crossing a road accompanied by an adult and not playing near a road. A more detailed description of the evaluation methods and the results of the study is described elsewhere (Cross et al., 2000).

CONCLUSION

A paucity of literature exists in the area of applied child pedestrian safety research to guide researchers' and practitioners' translation of theories into practice. This article provides an example of how theory was used by the Child Pedestrian Injury Prevention Project researchers as a valuable reference point to plan for, design, implement, and evaluate a pedestrian safety education intervention. The CPIPP educational intervention was based on four groups of contemporary theory that focus on individuals' behavior, children's perceptual and motor development and the relationships between individuals and their environments, and organizational change and implementation.

There is concurrence that if intervention strategies are based on a careful understanding of relevant theory and systematic approaches to their design, targeting, implementation, and evaluation, there is a greater

likelihood that programs will be effective (Gielen & Sleet, 2003; Glanz, Lewis, & Rimmer, 1997). It is reasonable to assume that the theoretically driven process employed by the CPIPP project strongly contributed to its success.

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The National Youth Violence Prevention Resource Center was established by the Federal Working Group on youth Violence and the Centers for Disease Control and Prevention. The center provides access to critical information on youth violence and effective strategies to control and prevent violence. The center includes a bilingual (Spanish/English) toll-free telephone information line (1-886-SAFEYOUTH [1-886-963-8484]); and internet site [www.safeyouth.org], technical assistance and a clearinghouse for information and resources for parents, teens and health care professionals.



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