The Conceptualization of Injury Prevention
As Change in Complex Systems

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March, 2004
Introduction

Injury prevention is occupying an increasingly important role in public policy. The general public is beginning to recognize the extent, cost, and personal burdens associated with injury, while governments and other institutions acknowledge that injuries are not inevitable chance occurrences and can be prevented. When examining the literature on injury prevention, however, competing language and models are evident, and though a considerable body of work has emerged and some progress has been made, it must be acknowledged that little has been accomplished in developing a solid evidence base for either universalistic or targeted preventative interventions.

Some programs represent prevention by fiat, and rest in ignorance of the definitions of this approach; others consist of attempts to repackage but not materially alter previously existing work. This provides some programs with the valued prevention label. Other programs meet the requirements for prevention but fail to produce demonstrable outcomes.

Nearly everything that involves people, from anti-pollution laws to legal limits on go-carts, can be seen as having implications for injury prevention, yet most of these relationships are vague and tenuous. In the face of this situation, prevention organizations are surely obligated to provide a clear justification for how their programs relate to important aspects of dealing with the problem of injury. It is precisely this justification that is lacking in many programs. Thus, the lack of a holistic explanation of what works and what does not work in injury prevention is evident. At this point we simply do not know enough about the multiplicity of functions which converge in the causes of injury, but little prevention would be accomplished if all our efforts were spent simply trying to further elucidate etiology. Although some injuries are known to result from specific mechanical failures, these comprise only a small proportion of what constitutes a preventable injury. Consequently, a descriptive focus on context is highly relevant to injury prevention since the etiological theories do not provide specific enough information to direct programs aimed at individuals who have not yet been identified as at risk.

The idea that injury prevention needs a model of person–environment interaction is not new. Haddon (1972) argued that strategies of prevention should be founded on complex views of the person–environment interaction. One may argue that much of the difficulty in developing genuine, valid injury prevention programs stems from an incomplete portrayal of this complexity. This inadequacy has resulted in the inability of many injury prevention efforts to demonstrate a link to desired outcomes, or to articulate the connection between risk and protective factors at play in most prevention programs.

An additional consideration points to a problem that is more insidious and far-reaching. In the absence of appreciating prevention programs in context, there is often a tacit assumption that specific etiological factors are known. The manifestation of this assumption is the narrowness of goals that characterize many preventive efforts. Injury prevention needs instead to be conceptualized broadly enough that it can subsume a wide variety of specific scientific theories and the insights derived from research in a variety of
disciplines. Moreover, a broad conception of injury prevention enables several programming difficulties to be overcome. Many programs provide services potentially relevant to prevention but with no demonstrable connection to injury prevention. Thinking contextually would allow these undertakings to be considered as resources to the prevention effort. Furthermore, the place and potential of these resources would be understood in greater detail. This conceptualization is necessary before claims as to what constitutes effective prevention can be judged worthy or not. Injury prevention necessitates conceptualizing personal and social change in terms of whole situations. Ultimately this is a heuristically valuable way for designing and evaluating programs that avoids some of the pitfalls of narrow causal thinking described earlier. Risk and protective factors, for example, need to be seen as interacting system elements, comprising whole units and not as discrete attributes that are merely linked by cause and effect. Protective factors can be responses to risks, including changes that follow effective coping. It is more beneficial to an understanding of prevention to move from a view of risks acting on a passive individual to a conceptualization that accounts for active individuals responding to a continuum that may increase or decrease both protection and vulnerability (for example, vulnerability may be decreased by reducing exposure and negative chain reactions, or protection increased through opportunities to gain information and skill).

Laflame, Svanstrom, and Schelp (2000) point out that injury prevention has moved from an original focus on accident prevention conceived in ways similar to disease prevention, to broader conceptions that include both unintentional and intentional injury. This shift has instigated a further expansion of injury prevention to include safety promotion, and a resulting move away from seeking medical health outcomes by merely attending to incidence and etiology. This change has resulted in a necessity to focus on social conditions or mechanisms that support health and well-being. Since the Lalonde report in 1974 there has been a recognition that the key determinants of health status are social factors (status and support), income, education, employment, environment, gender, culture, and personal characteristics, circumstances, and choices (Evans, Barer, & Marmor, 1994). The Ottawa Charter for Health Promotion (WHO, 1986) focuses attention on the social and ecological factors that need to be considered in both primary and secondary prevention initiatives. Most importantly, the charter reduces the emphasis on the medical model in injury and highlights the importance of advocacy and mediation that will enable people to achieve independence and gain control over their lives. Because of this theoretical open-endedness, pluralistic sensibility, and conceptual flexibility, injury prevention research represents wide diversity in thought and practice.

Traditional approaches to injury prevention are often based on the assumption that people exist in a perilous environment: their daily lives involve constant risk, and they walk about as an injury waiting to happen. In response, the prevention of injury is often seen as a problem of risk management. Persons are depicted as problems to be managed. Consequently, prevention programs and policies are usually advanced after injuries occur. This approach operates as if injuries are problems that reside in the deficiencies of individuals; that by providing information, corrective thinking, and improved decision-making, the problems will be fixed – a line of attack similar to the individualistic response of strengthening the host that emerged in the early days of germ theory. The
causal split between individuals and their contexts has not yielded successful models of injury prevention. A vision of prevention is needed that incorporates the newly-emerging conception of people not in opposition to their environments, but as fused and embedded in them.

Although previous models on interaction and transaction have existed in the prevention sciences, a presupposition has remained that there is a split between persons and their environments. Overcoming this split is necessitated by an increased appreciation for the complexity of people in terms of their structural and functional competencies at all levels of analysis (molecular, sub-cellular, cellular, and organismic) and as a consequence of recent understanding of the horizontal and vertical coactions that characterize living systems (e.g. evolutionary genetics).

While prevention does work, unfortunately we do not always know why. On the whole, passive engineered solutions work best; that is, technological innovation and legislative intervention appear to be more effective than so-called active interventions based on socio/educational attempts to change behaviour. Passive solutions, however, are not that effective on their own: for example, building a safer car may contribute to driving faster. Consequently, both active and passive approaches to prevention are necessary. Effective prevention appears to require attention to interactions and transactions among people, and between people and their environments. This complexity makes it difficult to know how to evaluate what works, and how best to invest time and money in prevention.

Over the last forty years injury prevention has evolved into a set of ideas that encompass a broad range of concepts from a number of practice fields and academic disciplines. A trend derived from advances in studying the determinants of health of populations has led to a widening appreciation that looking at health as the mere absence of disease has been too narrow. The implication of this for injury prevention research is that both eliminating the mechanisms of injury and promoting health and safety are appropriate outcomes to be evaluated. It has also become evident that a traumatic event such as an automobile collision may have more consequences than tissue and bone damage, in so far as the event may trigger disease (infection) and psychosocial consequences. These realizations have increased the need for approaching injury prevention as an interdisciplinary enterprise.

Recent academic interest in the nature of person–environment interaction across the life span has resulted in the recognition that a synthesis of perspectives from multiple disciplines is needed to understand the multilevel integration involved in injury prevention. It requires a collaborative commitment within different disciplines to expand the scientific foundation of injury prevention. Effective measures often require participation by a variety of disciplines such as economics, engineering, epidemiology, law, medicine, psychology, and social work.

The importance of comprehensive interventions using complex conceptualizations of preventative programs must be underscored. That is, a conceptual framework that connects different aspects of mental, physical, social, and academic health should be
adopted when designing and evaluating prevention programs. Hence, multi-disciplinary collaboration and coordination that employ trans-disciplinary concepts of prevention are needed to meet the changing and diverse needs of the population. Effective practices must address how this multilevel approach is managed; for example, what practices and policies are in place to deal with the differences that arise within the complex real world in which injury prevention is practiced (Durlak, 1997).

What follows is a conceptual scheme that can help organize injury prevention research. The aim is to provide a framework that can cut across disciplines in a way that allows the complex and often paradoxical qualities of injury prevention to be tackled without the oversimplifying assumptions of uni-disciplinary research. This conceptualization corresponds with the recognition of the complexity of human change processes and the need for multi-disciplinary perspectives and mixed method research (Tashakor and Teddle, 2003). It is intended to be used by injury prevention designers and evaluators as a guide to requisite program features and areas that need to be taken into account when determining outcome effectiveness. The theoretical approach to be articulated offers a comprehensive basis for the consideration of injury prevention research. The life course orientation joins consideration of energy exchange with the potential importance of trajectories, transitions, and their timing, whereas the ecology of human development orientation emphasizes the significance of context and of viewing development as a function of person/environment interaction.

Injury Prevention As Change In Complex Systems

While there is widespread acknowledgement that evaluation of injury prevention efforts is important, the challenge of accurately assessing the quality of interventions and programs is daunting. Answering the fundamental questions, “What changed and why?” involves choices that reflect the differing research orientations of various disciplines.

The newly emerging discipline of prevention science mirrors the advent of developmental science; the systematic study of human change processes. Both fields represent people’s lives as a process of “becoming” in which they are agents interacting with a variety of influential, but not determinant, systems throughout their lives. Viewing people as agents of their own change in the social worlds they co-construct presents a significant challenge to both prevention and developmental science. Change in complex systems involves order and disorder, complexity and simplicity, individual and collective action, forward and reverse movement.

As an example, consider the following paraphrased illustration of these paradoxical features of living systems provided by the theoretical biologist Ludwig von Bertalanffy (1980) dealing with the simplicity of the complex: An ecosystem is a tangle of a thousand lives, each tracing an intricate path around, and sometimes through, the paths of others. Every move of a living creature (man or beast) in this context (city or jungle) is dependent on the behaviour of others: those who would eat it, and those whom it would eat. This behaviour occurs in response to the behaviour of others. Together these knotted present and future histories make up the irregular complex filigrees of life trajectories. Stand back and these individual paths blur into each other, resolving into gross patterns of existence. At this level something new emerges: simplicity. The sudden
twists and turns of individual lives give way to stable patterns. At this level chaos and order commingle. There is something about low level complexity that is responsible for high level simplicity. Increased differentiation and complexity in development leads to the emergence of a new, simplified, whole.

Clearly our view of change as it relates to injury prevention needs redefining. Moreover, the need for an altered view of change reflects deeper shifts in the natural sciences and humanities, suggesting that we are at a pivotal point in the history of ideas. Naive optimism that connected our knowledge of the world through material or quasi material indicators are eclipsed by the soaring abstractions of quantum theory and the blurring of traditional disciplinary boundaries in cultural studies. Thus, the challenge here is to provide a conceptualization of human change that may ultimately help in determining the nature of injury interventions, that is, what can be prevented and what will remain to be treated.

Foundations: Gibson and Haddon

The work of J.J. Gibson provides an important starting point for the provision of a holistic conceptualization of injury. Gibson’s contribution was made a key feature in William Haddon’s seminal efforts to advance the conceptual basis of injury research. Haddon (1972) noted, “Gibson provides an analysis of ‘the ecology of danger’ that ‘represents a refreshing departure both from purely statistical approaches and from the narrow study that deals only with variables of one type and neglects the ecological context’”. Although most reviewers focus on how Haddon used Gibson’s observation that injury was due to a transfer of energy that exceeded the threshold for tissue damage, our use will draw more on his insight into the role of ecology or context in human behaviour and development.

In a short article “The contribution of experimental psychology to the formulation of the problem of safety” Gibson (1961) noted that there are five agents common to all injury events that correlate to the five forms of physical energy – mechanical, chemical, thermal, electrical, and radiant. On the basis of this observation, he asserted that in order to understand the causes of injury, it is essential to identify the sources of physical energy involved. Once identified, preventative efforts can be accurately directed to these proximal sources and not solely deflected on distal causes such as speed or alcohol impairment. Rivara (1995) point out “most of our injury prevention strategies, such as helmets, air bags, seat belts, and lowered tap water temperature, are based on this premise”.

Building on this premise, Haddon pointed out that injuries have three phases. During the pre-event phase control of the energy source is lost. Next, during the event phase, energy is transferred and damage may or may not occur. A passenger wearing a seat belt may have force applied to his or her pelvis and chest as opposed to an unfastened occupant whose skull collides with the windshield. Haddon added that in some injuries (e.g., drowning) damage is not brought about by a transfer of energy but by disruption in normal energy exchange (or, more accurately, e.g., breathing). The third post-event phase can involve limiting or repairing damage associated with the event.
These three phases correspond to the traditional prevention levels triad of primary, secondary, and tertiary prevention. As this model evolved, Haddon added the public health triangle components of agent, host, and environment to develop his now famous matrix as a research tool. The agent is energy; the host is the person at risk of injury. Injury occurs when atypical energy is exchanged or not exchanged. This occurrence is set in social, cultural, and physical environments. Energy transfer may occur through both inanimate objects or vehicles and animate objects or vectors. The three time phases are used in the matrix as rows to divide the four component columns outlining energy, agent, host, and vehicle/vector.

This “energy exchange” approach to injury prevention helped shift research from being largely descriptive to becoming etiological. As Haddon (1980) pointed out, this shift has characterized advancements in medicine and “opened the door to the possibility of manipulation and control”. Injury was perceived much like a disease and consequently amenable to being approached as a preventable health problem.

As described by Haddon, injury involves complex person–environment interaction. It is the nature of this interaction that the contextual systems conceptual scheme (CSCS) advanced here addresses. In this model, context includes a geographical environment, an energy environment, a natural and an artifactual environment, and an animate environment that is both personal and sociocultural. None of these environments is sufficient in itself to describe and explain the nature of injury in a way that preventative interventions can be evaluated. The demand of weaving all these components together has been hampered by the almost idiosyncratic methods and concepts of the various disciplines that are stakeholders in injury prevention. The shortcoming of most discipline-based research is that it usually begins with a reductionist account of causes of injury into component parts. As noted above, however, injuries involve a fusion of components and are determined by multiple causes. The challenge is to ascertain how these components are organized and weighted in any prevention effort. The conceptual scheme advanced here offers a synthesis across disciplines that is designed to guide injury prevention and safety promotion research. In serving this objective, focus is on the holistic nature of human change processes and the importance of time in understanding human adaptation as part of a complex contextual system.

Developmental Science: Life Span and Life Course Dynamics

Injury can be conceived of as part of an ongoing flow of events understood by applying insights from developmental science. Although there have been indirect applications, no systematic efforts have been made to extend our understanding of systematic change in human development to conceptualizing injury. Injury is an incursion in the life course and a potentially serious deviation from a path to successful development. In its efforts to understand change, developmental science incorporates two important traditions: life span approaches that specify the temporal order of life stages and life course perspectives that emphasize social trajectories that incorporate culture and history in their study of life events. Together these views provide a set of assumptions that have guided the formulation of the conceptual scheme outlined here (von Bertalanffy, 1980; Elder, 1991).
Operating Assumptions and Propositions

Injury prevention is about culture and society, communities and neighbourhoods, families and friends, life styles and ways of thinking. The assumption we begin with is that injuries are preventable, not chance occurrences. Moreover, we assume that individuals, although fused with their social situations, make decisions and choices that impact safety and security. Following the SMARTRISK model (1999) we also assume that risk, much like Selye (1964) pointed out about stress, is a part of life. Ensuring safety involves being “smart” about these necessary risks. We assert that security is achievable to the extent that the ability to accept and “live with” the consequences of risk decisions can be enhanced as part of planned preventions (Blatz, 1966).

Finally, we assume that the four “E”s of prevention (education, engineering, enactment, and economics) must coexist for an initiative like the one we propose to achieve its objectives. In combination they have the capacity to increase social capital in a community and increase the probability of creating a culture of care (safety). This context, in turn, should foster a person's understanding, motivation, intention to deal with life risks, and acceptance of the consequences of associated decisions (security).

The following sections bring together life course and systems theories to account for the possibility of change resulting from preventive interventions that seek to alter person–environment interaction. The conceptual scheme derived from these theories strives to enable prevention research to address the ways in which these interactions produce differing individual and collective orientations to injury and risk. To this end, the following co-requisite propositions of developmental science will be addressed:

1. Life is characterized by continuous change. Consequently, human development is a lifelong process. An inherent part of human life is interplay between social and personal change. Age and events are useful organizers of ways of understanding efforts to influence change such as preventative interventions.

2. Humans are agents in their personal change and changes in their social context. That is, they make decisions and choices that have consequences for themselves and others.

3. Context acts on individuals by limiting choices and opportunities. Time and place play an important role in shaping the nature of social and personal change. The things that occur in a person’s life can change the meaning of events for both self and others.

4. Human life is lived and sustained through interconnected social relations.

5. The way in which people think about injury relates to the way their environments are organized, i.e., safety and security are contextual.

6. Building communal culture, in the form of knowledge and beliefs, is crucial to influencing a person’s life course; it is primarily activated through social acts (as the process of interpretation) and related to the search for meaning.
7. Community context, or that which surrounds human existence, is a complex (problematic) system made up of sociocultural (historical), interpersonal, intrapersonal, and physical features that contain, paradoxically, both challenges (injury risks) and life chances (safety and security).

8. Human beings are purposeful actors within their environments who develop new (adaptive and non-adaptive) ways of acting in “old” environments, change these environments by their actions, and construct the bases for potential new kinds of life events (which may include injuries).

9. Person–environment (or social companion) transaction is different for individuals with different characteristics (e.g., difficult temperament; family risk history; sex, age, early antisocial behaviour patterns, etc.).

10. Both human beings and their environments are structurally organized wholes that function as integrated totalities (emergence). This totality derives its characteristic features and properties from the interaction among elements involved and not from the effect of each isolated part. The altering of one part leads to changes in other parts.

11. Environments are constantly modernized in accordance with contemporary technology; in turn, that modernization creates opportunities for the emergence of previously unknown or rare accidents.

12. The linking of long-term views of the life course with human ecology highlights the significance of change through time and context as joint functions of persons and their environments.

13. Any action taken to prevent injury in one setting (or developmental level) should be monitored in other settings (environment change can lead to future hazards).

Most injury prevention programs are organized around specific injury producing events and not around producing generally safe conditions or safety awareness. Where injury prevention is effective, there is often a combination of legislative, educational, behavioural, technological, and economic practices. Passive prevention (enactment and engineering) appears more effective than active approaches relying on education and economic incentives. Rigorous evaluation of the many well-intentioned prevention strategies that are in place worldwide is rare.

Effective injury prevention programs and strategies are designed to bring about change. Although these preventative interventions usually begin at a particular entry point into a contextual system, they need to address all sectors. Thus, a common feature in their evaluation is consideration and eventual involvement of relevant systems. These systems in essence own the conditions and transformative processes that contribute to the occurrence of injury. They need to address issues and come together to change conditions. A systems-oriented prevention process assumes that efforts to reduce injury
involve interventions that change settings, situations, and the way people think and behave.

Personal and social factors interacting in the change process are often labeled as development. The nature of the interplay between the unfolding of individual lives, social structure, and culture, is largely unknown. Decades of research in this area have produced little or no consensus as to how macro and micro perspectives can be combined. There is a need to bring to the study of human development ideas and indicators that encompass social structural, social psychological (interpersonal), psychological, bio-physiological, and physical features of human existence and experience. Inherent in the interdisciplinary approach taken here is the assertion that human development is more than a function of the independent properties of the person and the environment. Rather, development is conceived of as a consequence of both the person and the environment, a result of the joint functioning of individuals and their context. Context is an abstraction of the environment that includes objective circumstances and subjective definitions of situations accorded to events and action. Development is, therefore, inextricably tied to context.

A conceptual scheme can help to make salient new individual characteristics defined as part of the system in which they operate. Portraying prevention as a planned intervention in human development involves exploring emotional, cognitive, anatomic, physiological, ecologic, and behavioural change in living systems. The context of development contains both risks (challenges) and protective factors (resources). Challenges catalyze change; resources support individual change. At different times and in different situations what was once a challenge might become a resource, and vice versa. The critical feature explaining development is the transaction between a person and his or her context. Through a process of interpreting, choosing, manipulating, and adapting to their contexts people play a role in their own development. The contextual systems that constitute an individual life space include both internal and external environments in which a person interacts and adapts. Contained in the life space are the resources and the challenges that become evident during the life course. Context may be pictured as a circle with four main components: sociocultural, interpersonal, ecological (physical environment) and internal states (see Figure 1). This division into quadrants is arbitrary and serves primarily analytic purposes. In reality the life space is a complex fusion of elements.
Figure 1: Four Divisions of the Life Space

Sociocultural

- Socio-economic status
- Language (Idiom)
- Norms and Values
- Reference Groups
- Family Composition
- Religion

Interpersonal

- Temperament
- Primary Relationships
- Reference Relationships (natural and professional helping networks)

Physical Environment

- Housing
- Living & play space
- Neighbourhood composition

Internal States

- Health
- Self-Esteem
- Sense of Well-being
- Quality of Life
The Sociocultural quadrant consists of norms, values, and language. Interpersonal relationships involve actual interactions with others, the social basis for organizing experience (cognition) and the personal residues of relations with others. The Internal States dimension involves the genetic program, biochemical processes, and unconscious phenomena. The Physical Environment dimension contains both man-made and natural objects.

Evident in the four quadrants are four components underlying prevention as change/development: 1) the sociocultural opportunities available or the obstacles encountered as influenced by social class, ethnic membership, age, sex, personal contacts; social calamity (war, earthquake, and famine), economic adjustment and major and minor social and technological change; 2) the sources of interpersonal support accessible to an individual; 3) what the physical environment offers in terms of stimulation, support, and security (e.g. these are representative, not a complete list) colours, textures, stairs, and walls; and 4) the personal resources that an individual can command – his intelligence, appearance, strength, health, and temperament – investments of effort that the individual makes on his or her own behalf. Although the content of systems is highly variable, we can begin to discern common structural features of how change is brought about in the course of human development over the entire span of life.

A CSCS Conceptualization and Evaluation of Children’s Falls Prevention

Children’s falls prevention can be used to illustrate the use of the complex systems conceptual scheme (CSCS). A fall occurs when a person descends by the force of gravity and comes into contact with the ground or other object at a lower level. This example will focus on falls from heights, on level ground, and on stairs.

Understanding the risk and protective factors associated with unintentional childhood injuries due to falls is complicated. To ensure that decision making associated with falls prevention is based on the best available knowledge, the CSCS can be used to provide a systematic multifaceted way of organizing evaluation-relevant data.

Falls have been documented as the leading cause of injury related hospitalization among children (Health Canada, 1997). The Chief Medical Officer of Ontario Health Report 2002 asserts that a twenty percent reduction in the incidence of falls for children aged 0 to 9 would result in nearly 500 fewer hospitalizations, 4000 fewer non-hospitalized injuries, and 185 fewer injuries resulting in permanent disability. This reduction in the personal and familial burden of suffering would also reduce the economic burden of injury in Ontario by 44 million dollars. Forty percent of these hospitalizations are due to falls from playground equipment, stairs, during sports activities, from a chair or bed, or from a building. Younger children tend to fall at home whereas fall related injuries in older children occur during sport or at school. For infants, falls occur most commonly from a resting position; older children tend to be active when they fall. The head and neck are parts of the body commonly injured: the second leading cause of traumatic head injury is falling, preceded only by unintentional injuries suffered in motor vehicle accidents. The rate of death and injury due to falling is greater for boys than girls. Climbers, swings, and slides seem to be the pieces of equipment on which
children most often injure themselves. In the majority of cases (77%), the injury was fracture or dislocation, and was the result of a fall from the equipment on which the child was playing (Health Canada, 1997). The percentage of injuries to the head and neck declined with age and was usually related to a fall from another level. In children aged 1–4, the percentage of head injuries following a collision or a fall from a swing or slide is greater in public playgrounds than at home. Preschool children are at particular risk for severe head and neck injuries in farm settings (45.6% in 0–4 age group). Inadequate supervision is noted as a risk factor in these injuries, with, once again, boys being injured more often than girls (Volpe et al, 2002).

The CSCS Injury Prevention Evaluation Model

Coupled with a variety of injury prevention research frameworks, the complex systems conceptual scheme allows injury prevention research to be conceptualized in four interrelated components: interpersonal relations, intrapersonal (internal) states, the physical environmental and the sociocultural. This conceptual scheme allows injuries to be seen in a context comprised of personal, cultural, and environmental factors. Moreover, this conceptualization enables prevention research to address the ways in which these elements interact and change over time to produce differing individual and collective orientations to injury and risk. Within this scheme behaviours are depicted as ‘adaptations’, brought on through the application of available resources to meet internal and external demands of a variety of personal and societal variables which in the life course provide experience and shape for developmental outcomes. These adaptations occur within a life space and involve one or more dimensions of human social experience and relationships. Because preventative change requires alterations in both environments and usual patterns of thinking and behaving, it must be recognized that such change can, paradoxically, both motivate learning and foster positive development, or be overwhelming, paralyzing, and debilitating. The transactional nature of injury can be usefully conceptualized to incorporate the dynamic quality of interventions aimed at changing behaviour. Neither environmental nor behavioural strategies alone can prevent injuries. Both together, however, may improve the chance of preventative interventions succeeding. Many complex tasks in nature and society are accomplished through redundant means where the same goal is attained by different but parallel methods. The transactional and paradoxical nature of injuries and their prevention necessitates that policy relevant research conceptually link environments to behaviour.

The CSCS Organizing Data Sources

The life space of the child depicted in Figures 1 and 2 can be used as a way of laying out data sources and portraying the dynamic interplay of complex systems. Below are possible data sources that join quadrants and make some more salient than others due to data availability.

A - Interpersonal relations:

- General population
  - Available data-sources such as Statistics Canada.
Observation of safety-related behaviour
• Parents/Guardians and Grandparents of children involved in the school-based intervention
  o Questionnaires
  o Selected number of parents: focus-groups

B - Sociocultural:
• General information
  o Socio-economic indicators, allocation of resources, etc.
• Community-based agencies
  o Human Service Integration Index measures the degree to which communities achieve integration by examining the scope, depth, and outcome (Partnership Synergy and Efficiency) of integration
  o Focus groups with key-informants
• Cultural, recreational, health, religious, social and voluntary organizations
  o Survey: information about membership rates, active organizational involvement, volunteering, amount of philanthropic generosity
  o Focus groups with key-informants
• Social/political institutions
  o Documentation of political and legal changes on a municipal level (e.g., through content analysis of local newspapers)
  o Survey of the legal system (e.g., number of criminal charges, civil law suits as indicators of social cohesiveness)
  o Focus groups with key-informants

C - Physical environment:
• Neighbourhood: Condition of houses, etc.
• Sampling of safety-related features in the environment (documentation available from municipal and provincial agencies concerning safety features of roads, buildings, etc.).

D – Injury state of the Organism (injury data) and the intrapersonal (knowledge and skill) data:
• Hospital Emergency Department Reports
• Children involved in the school-based intervention
  o Questionnaires (behaviour and knowledge)
  o Selected number of children: in-depth semi-structured interview
  o Observation of traffic related behaviour in vicinity of the school (e.g., use of bike helmets).

The transactional nature of childhood injuries and their prevention depicted above prescribes to child caregivers and social policy makers an emphasis on the mutually linked use of environmental and behavioural means to reduce risks. It is important to reiterate that neither environmental nor behavioural strategies alone can ensure safety. Together, however, they offer more potential for improving safer outcomes.
Conclusion

Each system complex is different, with unique weaknesses and strengths. For this reason, programs and projects should be developed to best fit the injury that is the focus of the research. Programs that use a variety of approaches are most likely to be successful. The need for combining education, safety products, legislation, enforcement, and modified physical environments illustrates the multi-faceted approach to a successful injury prevention program outlined above and in Figure 3.

Help is needed to redress a loss in descriptive emphasis that resulted in attempts to further causal explanations of injury. Questions of why injuries occur have often taken precedence over how injuries occur. Both are important. The success of science can be related to explanations of why things occur that are solidly based on accurate descriptions of how they occur.

The preceding conceptualization of injury prevention as a deliberate attempt to bring about change enables one or more of the quadrants to be salient in data gathering and analysis. However, it is important to recognize that a consideration of all elements of the life space is necessary to succeed in injury prevention.
General Bibliography


Figure 2:

Children’s Falls
- Injury surveillance
- Hospital Admissions
- Visit to Emergency Department
- Medically treated injuries, but not 1-3 (e.g., EMTs, GPs)
- Not medically treated injuries

Sociocultural
Directly observable:
- Law enactment / enforcement
- Allocation of resources
- Membership rates in organizations
- Amount of philanthropic generosity

Indirectly observable:
- Level of service integration
- Interprofessional relationships
- Organizational Climate

Interpersonal and Intrapersonal
Directly observable:
- Community involvement
- Traffic behaviour

Indirectly observable:
- Injury related knowledge
- Attitudes
- Beliefs
- Relationships
- Trust

Physical environment:
Directly observable:
- Safety features of roads, buildings, etc.
- Traffic engineering
- Condition of houses etc.
**Figure 3: The Prevention of Children’s Falls**

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<thead>
<tr>
<th>Sociocultural</th>
<th>Interpersonal</th>
<th>Physical Environments</th>
<th>Internal States</th>
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</thead>
<tbody>
<tr>
<td>Community</td>
<td>Primary &amp; secondary relationships</td>
<td>Where we live</td>
<td>Biochemical/genetic and means of coping</td>
</tr>
<tr>
<td>• Awareness raising component that falls are preventable</td>
<td>• Parents and teachers</td>
<td>• Safety audits of home and public areas</td>
<td>• Empowerment of children through increased knowledge and skill</td>
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<tr>
<td>• Use of schools to deliver prevention messages</td>
<td>• Peer relationships through</td>
<td>• Participation of local businesses</td>
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<td>• Policy development of falls prevention in public places</td>
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<tr>
<td>• Multi-faceted approach that includes teachers, medical practitioners, community health nurses,</td>
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