

**Motor Development as a Context for Understanding
Parent Supervision and Infant Injury Risk**

by

Amanda K. Cox

**A Thesis
presented to
The University of Guelph**

**In partial fulfilment of requirements
for the degree of
Master of Arts
in
Psychology**

Guelph, Ontario, Canada

© Amanda K. Cox, August, 2016

ABSTRACT

MOTOR DEVELOPMENT AS A CONTEXT FOR UNDERSTANDING PARENT SUPERVISION AND INFANT INJURY RISK

Amanda K. Cox
University of Guelph, 2016

Advisor:
Dr. Barbara A. Morrongiello

Unintentional injury is the leading cause of death for children ages 1 through 18 years old, and is among the top causes for emergency room visits, hospitalizations and disabilities. For infants', majority of injuries occur in and around the home particularly when they are acquiring new motor skills. The aim of the current study was to examine how parental safety practices change over the course of three developmental time points: pre-mobile, becoming mobile, and independently mobile. Parent-infant dyads ($N = 83$) were recruited, with infants' being tracked for an average of 6 months. Results revealed that infant's injury-risk behaviours were predictable across motor development, with infants' engaging in the same types of activities that resulted in injury occurrences across time. Although supervision was a strategy applied across all stages, parents' maintained closer supervision for the independently mobile infants' compared to other stages of development. Implications of these findings are discussed.

Key words: infants', motor development, parent safety practices, supervision, injury prevention

Acknowledgements

First and foremost, I would like to thank my advisor, Dr. Barbara Morrongiello for her constant support, encouragement, and guidance throughout the past two years. Your devotion, enthusiasm, and passion for research is truly inspiring, and I am grateful to have had the opportunity to work under your supervision. Thank you for always challenging me to reach my next milestone and for believing in my abilities to succeed. I am certain that without your guidance, I would not be where I am today.

I would also like to thank my committee member, Dr. Scott Colwell for his unwavering support throughout this process. I am so honoured to have had the opportunity to continue to work with you throughout my Master's. I cannot thank you enough for your guidance and patience throughout analyses and for always willing to help. You have truly gone above and beyond your role as a committee member.

Next, I would like to thank Dr. Meghan McMurtry for her thoughtful input and feedback during my thesis defense. I'd also like to thank Dr. Karl Hennig for his enthusiasm in chairing my defense. To the staff, students, and volunteers in the Child Development Research Unit, I cannot thank you enough for your help along the way. I feel blessed to work with such an incredible team of researchers who are always willing to go out of their way to help others.

I would also like to express my appreciation for my Psychology colleagues and to my cohort. You have all been an incredible support system over these past two years. Thank you for supporting me, encouraging me, and believing in me.

Finally, thank you to my family and friends for providing me with constant love, support, and encouragement. To my mom and sister, thank you for listening to me when I needed to discuss ideas, and for giving me a shoulder to cry on when things got difficult. I can never thank you both enough for everything you have done for me. I feel so lucky to have two amazing women as role models in my life.

To my dearest friend Samantha, thank you for always being there for me, no matter what I needed. Thank you for keeping me motivated throughout the challenging times, and for celebrating successes with me when things were going well. Your friendship means the world to me and I am grateful to have you in my life.

To my fiancé Raj, thank you for believing in me and supporting me throughout this process. You have always encouraged me to strive for the best, and I would not be where I am today without you. I am incredibly lucky to have you by my side throughout this journey, and feel blessed every day to have you in my life. Thank you for being everything that I need and for always believing in my dreams.

Table of Contents

Abstract.....	ii
Acknowledgements.....	iii
Table of Contents.....	iv
List of Tables.....	v
List of Figures.....	vi
List of Appendices.....	vii
Introduction.....	1
Factors Related to Injury-Risk.....	3
Supervision and Injury-Risk.....	4
The Current Study.....	7
Method.....	8
Participants.....	8
Measures.....	9
Procedure.....	13
Data Coding, Analytic Approach and Checking Procedures	15
Results.....	20
General Discussion.....	35
Contextual Analysis of Risk Behaviours and Unintentional Injuries	37
Factors Affecting Infant Injury-Risk.....	39
Supervision and Injury-Risk.....	41
Relationship Between Injury-Risk, Unintentional Injury and Supervision.....	43
Limitations and Directions for Future Research.....	45
Conclusions.....	46
References.....	49

List of Tables

Table 1: Average Supervision Level Across Motor Stages.....	62
Table 2: Injury Occurrences by Infant Activity Type.....	63
Table 3: Injury Type Across Motor Development Stages.....	64
Table 4: Injury Occurrences by Parent Activity Type.....	65
Table 5: Summary of Regression Statistics for Model 1.....	66
Table 6: Summary of Regression Statistics for Model 2.....	67

List of Figures

Figure 1: Input path diagram for Model 1.....	68
Figure 2: Input path diagram for Model 2.....	69
Figure 3: Child and Parent Attributes for Future Research.....	70

List of Appendices

Appendix A: Ethics Approval.....	71
Appendix B: Motor Development Checklist (MDC).....	72
Appendix C: Supervision Time Use Information Sheet.....	73
Appendix D: In View Diary Sheet.....	74
Appendix E: Out of View Diary Sheet.....	75
Appendix F: Injury Diary Form.....	77
Appendix G: Risk Behaviour Diary Form.....	80
Appendix H: Process for Creating Coding Manual.....	81

Unintentional Childhood Injuries

Unintentional injury is the leading cause of death and disability to children worldwide (Borse et al., 2009; Chandran, Hyder & Peek-Asa, 2010; Krug, Sharma & Lozano, 2000; Parachute, 2015) and has been described as the most serious and under-recognized health concern that children in the industrialized world face today (Borse, 2009; Dal Santo, Goodman, Glik & Jackson, 2004; Public Health Agency of Canada, 2006). In Canada and the United States, more children die annually from unintentional injuries than from the next five leading causes combined (Anderson, Minino, Fingerhut, Warne, & Heinen, 2004; Parachute, 2015; Safe Kids Canada, 2010; World Health Organization, 2008). When examining Canada specifically, unintentional injury accounts for 225,000 hospitalizations, 3.5 million emergency room visits and 16,000 deaths annually (Parachute, 2015; SmartRisk, 2009). More strikingly, approximately 43 Canadian children die each day as a result from unintentional injuries (Parachute, 2015) and research has shown that every minute and a half a young child is seen in the emergency department for a nonfatal unintentional injury (Mack, Gilchrist, Ballesteros, 2008; Ontario Ministry of Health and Long Term Care, 2002). The direct financial impact of pediatric injury in Canada is immense, accounting for \$27 billion dollars in total health care costs in 2010, a significant increase of \$7 billion dollars since 2004 (Parachute, 2015). It has been predicted that by the year 2035, unintentional injuries will account for approximately \$75 billion dollars spent annually and will result in 71 childhood deaths per day if we remain on the same trajectory (Parachute, 2015).

While unintentional injury claims the lives of more children than any disease (Parachute, 2015; Centers for Disease Control and Prevention, 2012; Grossman, 2000), research

has found the vast majority of these injuries to be *predictable, preventable,* and *controllable* (Centers for Disease Control and Prevention, 2012; Dowd, Keenan, & Bratton, 2002; Fuselli, Groff, Nesdale-Tucker, Waldie & Wanounou, 2011; Rimsza, Schackner, Bowen, & Marshall, 2002), despite the fact that many caregivers perceive them to be “accidental” (World Health Organization, 2010; Safe Kids Canada, 2006; Morrongiello & Dayler, 1996) or simply a result of a child’s unpredictable behaviour (Morrongiello & Schwebel, 2008). The common misconception that injuries are inevitable ignores the fact that the *majority* of these injuries (i.e. 50 – 90%) can be avoided through the adoption of effective prevention measures (Fuselli, Groff, Nesdale-Tucker, Waldie & Wanounou, 2011; Morrongiello, Corbett, McCourt, & Johnston, 2006; Parachute, 2014; World Health Organization, 2008). Although there has been an increase in implementing prevention strategies to reduce the burden of unintentional injuries, the majority of these have focused on external environmental modifications for children 2 years and older (i.e. bicycle helmets, road safety improvements, warning sign labels, restricting access to hazards) and have not considered how parenting practices impact younger children’s safety. Given that most injuries to young children (< 2 years) occur in and around the home (Centers for Disease Control and Prevention, 2012; Flavin, Dostaler, Simpson, Brison & Pickett, 2006; Phelan et al., 2005; Lyons et al., 2003; Reading, Langford, Haynes, & Lovett, 1999; Rowntree, 1950), particularly when they are acquiring new motor skills (Agran et al., 2003), it is essential to understand what caregivers do to reduce children’s risk of injury and what motivates them to take this action. While research with older children suggests that caregiver supervision is a critical determinant of childhood injury (Morrongiello, Corbett, & Brison, 2009; Porter et al., 2007), virtually nothing is known about how supervision relates to injury-risk during infancy and the scope of supervision infants’ receive at home, irrespective of the fact that they are at a

heightened risk due to their quickly changing development (Fuselli , Groff, Nesdale -Tucker, Waldie & Wanounou , 2011). The present study will address this gap in the research literature.

Factors Related to Injury-Risk

Injury-risk during infancy represents a complex interplay between developmental abilities, environmental circumstances, and caregiver practices (Mack, Gillchrist & Ballesteros, 2008). While unintentional injuries are a concern for children of all ages, infants' are at particular risk due to their rapid change in physical development, which allows them to potentially interact with many injury hazards (Fuselli, Groff, Nesdale-Tucker, Waldie & Wanounou, 2011; Hammig & Ogletree, 2006). Indeed, research has found that the etiology of childhood injury varies as a function of age and developmental level (Fuselli, Groff, Nesdale-Tucker, Waldie & Wanounou, 2011; Morrongiello et al., 2004a; Safe Kids Canada, 2006), with infants' often sustaining injuries that coincide with developmental transition points, such as falls, burns, poisoning, choking and suffocation (Flavin, Dostaler, Simpson, Brison & Pickett, 2006; Mack, Gillchrist & Ballesteros, 2008; Powell & Tanz, 2002; Warrington & Wright, 2001).

Examination of the antecedents of unintentional injuries to young children reveals age-specific differences in how *risks change* as children develop. For example, injuries from falls increase at about 9 to 11 months, directly coinciding with when young children often acquire the ability to climb furniture and stairs (Agran et al., 2003; Berger, Theuring & Adolph, 2007), while injuries related to poisoning escalate between 15-17 months of age, consistent with the developmental timeframe of when infants' improve the ability to explore their environment and utilize dexterity to grasp and release objects (Agran et al., 2003; World Health Organization, 2008; World Health Organization, 2010).

Thus, infants' motor development capabilities largely determine *what* they are exposed to and *how* they interact with hazards in their environment. It is critical, therefore, that caregivers not only be aware of how developmental milestones increase infant's risk of injury, but also to be able to effectively anticipate the timing of the next major milestone in order to adjust their safety measures accordingly. Interestingly, although developmental milestones are associated with an increased injury-risk (Agran et al., 2003; Powell & Tanz, 2002; Rennie et al., 2007) and research has identified most injuries in infancy to be attributed to caregiver behaviour (Mack, Gilchrist & Ballesterois, 2007; Powell & Tanz, 2002; Rowntree, 1950), there has yet to be a study examining whether supervision level and infant motor development act synergistically to create injury risk. The need for this is critical as infants' motor capabilities often exceed the development of cognitive abilities that are required for avoiding injury-risk situations.

Supervision and Injury-Risk

Research has identified that parents tend to rely on three distinct types of strategies in order to manage children's risk of injury, namely, environmental strategies (i.e. hazard removal or using barriers to restrict access), child-based strategies (i.e. teaching children about safety rules), and parent-based strategies (i.e. close supervision). While environmental strategies have been a major focus of injury-prevention research, the available evidence suggests that this approach is not typically commonplace until the age of 2 (Garling & Garling, 1995; Morrongiello et al., 2004b; Thuen, 1992; Morrongiello et al., 2004), and that the implementation of this strategy *alone* is not sufficient enough to prevent injury to children under the age of 5 years (Lyons et. al, 2003). Moreover, research has shown that caregivers tend to transition to using predominantly teaching strategies between the ages of 2-4 years (Garling & Garling, 1995; Morrongiello; Ondejko & LittleJohn, 2004), when parents believe that children have developed

the ability to acquire knowledge of safety rules and manage risk of injury on their own (Morrongiello & Shields, 2001). In contrast to how much we know about what parents do to enhance home safety once children are mobile and reach the age of 2 years, there are surprisingly little known about what they do to prevent injuries to very young children.

While both environmental and child-based strategies are essential for reducing the risk of injuries, research has identified caregiver supervision to be the single most important factor for preventing injuries to *young* children (Morrongiello, 2005). Indeed, research conducted by Morrongiello and colleagues have established a link between supervision and injury risk for children between the ages of 2 and 6 years, as well for children between the ages of 8 and 10 years (Morrongiello; Ondejko & LittleJohn, 2004a, b; Morrongiello, 2005; Morrongiello et al., 2006a, b; Morrongiello, Brison & Corbett, 2009). What is not known, however, is how supervisory practices influence injury-risk for infants' and the scope of supervision they receive while at home. Addressing this gap, the current study aimed to identify factors that *influence* decisions about supervision and to examine how supervision *patterns* influence risk of injury for infants'.

An important consideration for examining parental supervision is deciding how to properly conceptualize and define the term. Interestingly, there appears to be little consensus on how supervision should be defined within the research literature (Morrongiello & Schell, 2010). While broad-based definitions have been posited by caregivers (i.e. "watching" and "overseeing") and dictionaries (i.e. "seeing", "overseeing", "managing"), they fail to differentiate between supervisory behaviours (e.g. directly observing child) and general monitoring techniques (e.g. knowledge of child's activity and location). Although general monitoring techniques may be sufficient to practice with older children, research has identified that continuous, close

supervision, is typically required in order to keep younger children safe (Morrongiello & Schell, 2010). Unfortunately, there are currently no clear guidelines on how parents should supervise children at different ages, or what “adequate” supervision entails (Morrongiello, 2010). Current research, however, suggests that direct attention (e.g. visual supervision) and caregiver’s ability to intervene (e.g. how quickly supervisor can stop risk-activity) are important facets that should be considered when defining supervision (Morrongiello & Schell, 2010; Saluja et al., 2004). Based on these recommendations, Morrongiello (2005) proposed a definition of supervision applicable to children under the age of 6 years, which includes 3 dimensions of caregiver behaviour: *attention* (e.g. the extent of watching and listening), *proximity* (e.g. within vs beyond arms reach), and *continuity* (e.g. constant/intermittent/not at all).

The usefulness of this definition has been supported in several studies that have found a relationship between level of caregiver supervision and frequency of child injuries (Morrongiello et al., 2004a, b; Morrongiello, 2005; Morrongiello, Brison & Corbett, 2009). For example, a study that examined in-home injuries experienced by children between the ages of 2 and 3 years revealed that lower levels of watchfulness (e.g. indirect supervision) resulted in an increase in frequency of injuries sustained (Morrongiello et al., 2004a, b). Similarly, a matched case-control study that examined the causation of medically-attended injuries for young children revealed that both parent’s attitudes towards supervising and actual implementation of supervisory behaviour (watching, proximity) was significantly lower for children who experienced injuries (Morrongiello, Brison & Corbett, 2009). Consistent with these findings, it has been found that lapses in caregiver supervision have been implicated in many types of household injuries to children, such as drowning, poisoning, and falls (Morrongiello, 2005), suggesting that active supervision is an important risk-reducing strategy for young children. Injury statistics suggest

that this may be particularly true during infancy as children become increasingly motorically competent and there are peaks in injuries at points of acquisition of motor milestones (Agran et al., 2003; Berger, Theuring & Adolph, 2007). The current study directly examined the relationship between infant motor development level and maternal supervision patterns.

Current Study

Building on past research, the focus of the current study is to examine how caregiver supervision practices change over a period of approximately 6 months as infants' become increasingly mobile (i.e. from just being able to sit up independently, to being able to walk independently), and to identify those supervision practices associated with fewer injuries. The current research will help to determine what parental factors influence supervision decisions and what supervision strategies are most effective in reducing childhood injuries in the home. Based on the presented literature, this longitudinal study measured *motor development level*, *parent supervision*, and the frequency of *injury-risk behaviours* and *in-home injuries* in order to address the following objectives:

Objective 1: The first objective was to examine the rate and nature of injury-risk behaviours during infancy, how parents became alert to these behaviours, and the frequency in which infants' engaged in similar behaviours previously.

Objective 2: The second objective was to examine the rate of injuries sustained during infancy, the types of activities that led to such injuries, and to determine the level of parental supervision during times of injury occurrences.

Objective 3: The third objective was to examine the relationship between injury-risk behaviours and parental supervision in order to determine how child and parent factors coincide with minor injuries sustained across motor development levels.

Method

Participants

Participants included 83 mother-infant dyads ($n = 43$ males, $n = 40$ females) with the average age of infants' at the start of the study being 8 months ($M = 7.9$ months, $SD = 2.01$ months). Caregivers of typically developing infants' were recruited throughout Guelph, Ontario using a database of families interested in research that is maintained in the Child Development Research Unit (CDRU) at the University of Guelph. This database is comprised of contact information for over 13,000 families who have been recruited through the Guelph General Hospital, as well as through community events (e.g. Parent and Tot swim classes, daycares). Caregivers were eligible to participate if their infant could sit up independently (i.e. without back support), but were not yet independently mobile in any way (i.e. not crawling), with participants being tracked until the infant was an independent walker (i.e. can take 3 steps or more without support). In general, the sample was comprised of families in the moderate-to-high income range, with most participants completing at least some level of post-secondary education. Specifically, maternal education for the sample showed the following distribution: 14% obtained a high school diploma, 29% completed a college degree, 35% completed a university degree, 15% completed a graduate degree and 7% completed post-graduate training. Annual family income distribution for the sample was: 2% earned below \$20,000, 9% earned \$20,000 - \$39,999, 6% earned \$40,000 - \$59,999, 13% earned \$60,000 - \$79,000, and 70% earned above \$80,000. The majority of the mothers (> 90%) indicated being married and not working outside the home on a regular basis. There was little ethnic diversity in this sample; nearly all families were Caucasian. This research project was reviewed and approved by the Research Ethics Board

at the University of Guelph (See Appendix A) and each participant provided written consent prior to the commencement of the study.

Measures

Caregivers completed diary recording sheets to provide continuous records of supervision across time, injury and risk behaviour diary sheets to report on the frequencies of occurrence in the home, and bi-weekly telephone calls to provide up to date information on motor development milestones. Additional measures of child and parent attributes were also completed, but will not be discussed in this thesis. All materials appear in the Appendix.

Infant Motor Development

Infant motor development levels were determined throughout the course of the study by using the Motor Development Checklist (MDC). This is a hierarchical scale which integrates three widely used measures; the Bayley Scales of Infant Development, Ages & Stages Questionnaire, and the Denver Developmental Screening Test, all of which have been validated in previous research to provide an accurate gross-motor development score (Frankenburg, Camp, & Van Natta, 1971; Naar-King, Ellis, & Fray, 2009; Schonhaut et al., 2013). The MDC is comprised of 6 distinct levels of motor ability (See Appendix B), ranging from pre-mobile (level 1 and 2), becoming mobile (level 3 and 4), and independently mobile (level 5 and 6), with higher scores indicating more advanced levels of motor ability (e.g., level 1 = sitting up without back support, level 6 = running without support).

Parental Supervision

A participant-event monitoring approach was used to collect data about parental home supervision practices. Caregivers completed Supervision Diary Recording Sheets to track their typical levels of supervision on several randomly selected days throughout the course of the

study. These forms have been implemented in previous publications which have found them to be a reliable and valid way of measuring supervision using self-report data (Morrongiello et al., 2006 a,b; Morrongiello, Klemencic, & Corbett, 2008; Morrongiello, Zdzieborski, Sandomierski, & Munroe, 2013).

Supervision Diary Recording Sheets were completed by the primary caregiver on a typical weekday, when both the caregiver and child are at home together in order to provide an accurate snapshot of how parents and children *usually* spend their time together in the home. The Supervision Diary Recording Sheets were comprised of *Time Use Information Sheets* (See Appendix C), *In View Sheets* (See Appendix D), and *Out of View Sheets* (See Appendix E).

Time Use Information Sheets. A Time Use Information Sheet was completed each recording day in order to track caregiver's typical levels of supervision, with a major focus on behavioural approaches to supervising (i.e. attention, proximity and continuity). The caregiver was instructed to begin recording from the time the child wakes up in the morning, continuing until the child goes to bed. The parent recorded the clock time for each diary entry, and was required to make a new entry whenever: there was a change in supervisor, the child's activity changed, the supervisor's activity or level of supervision changed, or the supervisor and/or child changed locations. For each entry, the caregiver also indicated who was supervising at the time (Mom, Dad, No one, or Other), whether the supervisor had the child in view or out view, and whether the supervisor and the child were doing something together. In addition, each time the caregiver made an entry on the Time Use Information sheet, they were also required to fill out an In View *or* Out of View Diary Sheet. The only time participants were *not* be required to fill out a corresponding sheet was when the activity lasted for less than 5 minutes, or when the caregiver and/or child left the house.

In View Sheets. An In View Recording Sheet was completed every time the supervisor noted that the child was “in view” on the Time Use Information Sheet. For the In View Sheets, caregivers was required to fill out either the top half, or the bottom half of the form, depending on whether they indicated they were “doing something together” or “not doing something together” on the Time Use Information Sheet (See Appendix D).

For both “doing” and “not doing” sections, parents indicated the room the child was in, who was supervising at the time, and their perceived level of infant’s ‘risk of injury’. For a “doing” activity, parents indicated the type of activity they were engaged in with the child (e.g., some type of childcare, playing/entertaining, other), whereas for a “not doing” activity, caregivers were asked to rate the level of supervision being provided to the child while they engage in separate activities (e.g., 1 = *not looking at the child and not listening closely*, 5 = *have him/her within constant view*).

Out of View Sheets. An Out of View Recording Sheet was completed when the supervisor indicated that the child was “out of view” on the Time Use Information Sheet. For the Out of View sheets, the caregiver indicated who was supervising at the time, the rooms that the child and supervisor were in, the activities that each of them were engaged in, and the level of supervision exhibited while the child was out of the supervisor’s view (e.g., 1 = *don’t have to monitor because the child knows how to behave*, 5 = *watching pretty much the whole time*)

Injuries in the Home

Caregivers also completed Injury Diary sheets throughout the course of the study, allowing for us to directly relate caregiver home supervision practices with infant home injury rates. Previous research has confirmed these diary sheets to be a valid and reliable way of tracking child related injuries (Morrongiello, Ondejko, & Littlejohn, 2004; Morrongiello, Kane,

& Zdzieborski, 2010) with caregivers readily reporting child-behaviour and parental home safety practices that may have contributed to injuries sustained in the home (e.g. caregivers leaving children unattended, and not removing hazards).

Injury Diary Sheet. During the course of the study, caregivers were asked to complete an Injury Diary Sheet *every time* their child experienced an injury in the home, with injury defined (cf. Morrongiello, Midgett, & Shields, 2001; Morrongiello, Ondejko, & Littlejohn, 2004) as tissue damage that persists for longer than 5 minutes (e.g. a bump, bruise, scrape, cut) including evidence which suggests internal, or nonvisible, tissue damage (i.e. choking or poisoning). Due to the increased probability of infants' experiencing distress from *very minor* injuries, we chose to employ a theoretical definition that would capture an accurate portrayal of the most *common* types of unintentional injuries that occur in the home (i.e. falls, cuts, poisoning, burns, drowning, and suffocation/ strangulation/choking) and the relative frequency in which these occur. In order to obtain this data, caregivers were asked to briefly describe the event that led to the injury, to indicate what part of the body was injured, to select the type of injury sustained, and to specify the location that the child and supervisor were in at the time of injury (See Appendix F). Additionally, caregivers were asked to rate how serious they believed the injury to be (e.g., 1 = *not at all serious*, 5 = *very serious*) and how much they agreed with the statement "closer supervision could have prevented him/her from getting hurt (e.g., 1 = *completely disagree*, 6 = *completely agree*).

Injury-Risk Behaviour Diary Sheet. Throughout the study, caregivers were asked to complete an Injury-Risk Behaviour Diary Sheet *every time* their child engaged in a risky behaviour within the home (See Appendix G). Previous research has confirmed these diary sheets to be a valid and reliable way of tracking child risk behaviours (Morrongiello, Ondejko, &

Littlejohn, 2004). For the purpose of this study, risk behaviour was defined as any behaviour that almost, could have, or did result in an injury to the child. In order to gain a better understanding of risk behaviours that occur during infancy, caregivers were asked to describe exactly what behaviour the child engaged in that was perceived to be dangerous, indicate where the child engaged in the risky behaviour, and provide information about parental supervision during the risk behaviour (e.g., who was supervising at the time, where the supervisor was during the event, the supervisor's activity during the risky behaviour, and how many minutes it had been since the supervisor laid eyes on the child). The caregivers were also asked to report the level of parental attention that was involved (e.g., if they were in view, out of view, within reach or beyond reach of the supervisor), if the child was caught in the act or afterwards, how they became aware of what their child did (e.g., heard, saw, someone alerted them, child said it, parent intuition, other), and the frequency of times this has happened previously. Caregivers reaction to the risk behaviour and their beliefs about prevention were reported using a Likert scale (1 = *not at all*, 5 = *very*).

Procedure

During an initial two-hour home visit, a research assistant trained each caregiver on how to correctly fill out diary recording sheets. The research assistant brought each participant their own binder which contained the following items: 1) Calendar Sheets 2) Time Use Information Sheets 3) In View Sheets 4) Out of View Sheets 5) Injury Diary Sheets 6) Sample Entry Sheets.

During the home visit, the research assistant read through the "binder script" with each participant to ensure each subject was getting the same information in a standardized manner. The binder script was made to help familiarize the participants with how and when to complete the diary sheets (e.g., every time there was an entry on the Time Use Sheet, the mother was to

complete either the corresponding In-View or Out-of-View Diary Sheet) and how to organize these sheets within the binder. To ensure a thorough explanation was conveyed, the research assistant completed several sample entries with the participant using information given by the caregiver about a typical day in their home. Monthly calendar sheets were also provided for participants to place on their refrigerator, which assisted in reminding participants about their scheduled recording days and to aid with tracking any injuries and risk behaviours that occurred in the home. The research assistant emphasized to participants that diary recording sheets should be completed as the day is unfolding, rather than to report retrospectively due to the scope of information to be recorded.

At the conclusion of the first home visit, the research assistant scheduled the participant's first supervision recording day to take place during the following week, using the constraint that they must record on a *typical* weekday. Additionally, the research assistant scheduled a follow-up home visit to take place immediately after the supervision recording day, in order to review the completed forms for accuracy and clarify any questions or concerns that the participants had. Upon review of the first recording day, the research assistant scheduled a second supervision recording day to be completed the following week.

In order to track infant motor development, the research assistant completed a motor development assessment using the MDC at each home visit in collaboration with the caregiver. Specifically, the research assistant asked the caregiver if the target infant had been able to complete each milestone *consistently* for at least two weeks (e.g., consistently = 80% of the time), in order to help avoid caregivers over-reporting their children's actual skill level. Following the two scheduled home visits, infant's motor development was assessed by completing bi-weekly telephone calls with the caregiver in order to track whether they have

achieved any new development capabilities during periods of supervision recording and child injuries. During these telephone calls, additional supervision recording days were scheduled at the rate of one recording day per month until the target child has reached a mobile stage of development (e.g., walking). E-mail reminders were sent to participants the day before their scheduled supervision recording day in order to avoid incomplete diary sheets and/or attrition.

Once the target infant could walk independently, as indicated by the MDC checklist, parents were asked to complete four additional supervision recording days (i.e., two recording days to be completed within two weeks of the new motor achievement, and two recording days to be completed one month past the new motor achievement) in order for us to directly compare supervision practices at the pre-mobile (e.g., only sitting), becoming mobile (e.g., crawling) and the post-mobile (e.g., walking independently and running) stages of motor development. At the completion of supervision recording days, a research assistant returned to the participant's residence to pick up the recording binder and to provide them with a Certificate of Completion and a \$25.00 gift card as compensation.

Data Coding, Analytic Approach & Checking Procedures

Injury-Risk Behaviour

Coding. A manual to code open ended responses (e.g., "Describe *exactly* what the child did that was dangerous") was constructed based on current theory on injury-risk behaviour and motor development, as well as preliminary data to determine common participant responses. Over several iterations of coding and refinement, always based on input from at least two independent coders, a final coding manual was implemented and yielded the data analyzed in this study. All open ended responses were double coded by two independent coders and

differences were resolved via consensus. Inter-rater reliability of the two independent coders was 92% agreement.

Analyses. Descriptive analyses were applied to calculate frequencies for who was supervising at the time of the risk behaviour (e.g., mom, dad, no one or other), to explore whether the supervisor became aware of the infant's behaviour during the act or afterwards, and to determine the frequency of the sample who reported risk behaviours across motor development stages (e.g., at sitting, crawling, and walking).

In order to analyze group differences for the various questions on the risk behaviour diary sheet, averages were computed for each participant across the three levels of motor development (e.g., average at sitting, average at crawling, and average at walking for each question) on selected diary items. A Repeated Measures Analysis of Variance (ANOVA) were conducted on the averages with motor developmental level (3: sit, crawl, walk) as the within-participant factor.

Injury Behaviour

Coding. The same approach as outlined above was applied to develop a coding manual for open ended responses (e.g., "Describe *exactly* what happened to result in your child getting hurt"). All open ended responses were double coded by two independent coders and differences were resolved via consensus. Inter-rater reliability of the two independent coders was 91% agreement.

Analyses. Descriptive analyses were used to calculate the time of day that injuries typically occurred (morning, afternoon, evening), to explore the frequency of each type of injury (cuts/scrapes/punctures, bumps//bruises/crushing/red mark, ingestion, and any combination of cuts/scrapes/punctures *and* any combination of bumps/bruises/crushing/red mark), to determine the frequency of activities that infants' were engaged in at the time of injury (physically active

play, physically active non-play, non-physically active play, inappropriate behaviour), as well as the frequency of activities that caregivers were engaged in at the time of injury (chores, leisure, something with the child, ordinary daily activities). Additionally, frequency analyses were used to determine the perception of who was most responsible for the infant's injury (bad luck, child, mom, other), to explore the frequency of infants' who engaged in this type of behaviour before, as well as to determine the frequency of infants' who have been injured as a result of this behaviour/activity before. Lastly, frequency analyses were used to determine whether caregivers have *already* implemented a safety precaution to decrease the likelihood that their child will get hurt in this way again, or, whether there is something that caregivers *plan to do* in order to prevent their child from getting hurt in this way in the future.

In order to analyze group differences for the various questions on the injury behaviour diary sheet, proportion scores were computed for each participant across the three levels of motor development (e.g., proportion at sitting, proportion at crawling, and proportion at walking) for selected coded categories. Repeated Measures Analysis of Variance (RM-ANOVA) were conducted using these proportion scores with motor development level (3: sit, crawl, walk) as within-participant factors.

Parental Supervision Level

Coding. The *Time Use Recording Sheets* were used to determine the amount of time supervisors spent in different situations (e.g., child was in view versus out of view) and how this varied with different supervisors (Mom, Dad, Other).

The *In-View Recording Sheets* were used to determine how much of the time a child and supervisor were in the same room and “doing something together” versus “not doing something together”. Supervision when *doing something together* was coded as 14, “have him/her within

constant view and within reach”, and was considered to be the highest level of supervision due to the caregiver displaying maximum auditory, visual and proximal supervision. Supervision for *not doing something together* was coded as 13 when caregivers “have him/her within constant view and out of reach”, 12 when “watching him/her intermittently and/or listening constantly”, 11 when “not watching him/her but listening closely”, and 10 when “not watching him/her and not listening closely”.

The *Out-of-View Recording Sheets* were used to determine the nature of the activities the child was engaged in while apart from their caregiver (i.e., nap time versus awake time periods), and to determine the supervisors’ activity at the time of entry (e.g., something to relax or for themselves, chores that involved another person such as changing the baby, or person-related tasks such as talking with dad). Additionally, the Out-of-View recording sheets were used to determine the level of supervision provided when constant parental supervision was not possible (i.e., because the child and supervisor were in different locations in the home). Supervision levels were coded as 9 when the caregiver was “watching constantly”, 8 when “listening in constantly”, 7 when “checking every 2–3 min”, 6 when “checking every 4–5 min”, 5 when “checking every 6–7 min”, 4 when “checking every 8–9 min”, 3 when “checking every 10 min or longer”, 2 when “only going to check on the child when he/ she hears something that indicates the child needs to be checked”, and 1 when “not supervising” (i.e., not checking or listening in at all). It should be noted that higher scores indicate higher levels of parental supervision. Overall, supervision scores from the Out of View entries reflect lower levels of supervision due to the fact that the supervisor was not within direct proximity of the infant.

Analyses. Supervision scores were calculated by averaging the level of supervision across all recording days for each stage of motor development, excluding time when the child was

napping or when the supervisor coded “don’t know”. Thus, each participant had a mean supervision score at sitting, crawling, and walking, which ranged between 1 and 14 (*Note*: higher scores indicate higher levels of parental supervision).

In order to examine how parental supervision coincides with injuries sustained during infancy, a time-adjusted injury rate was calculated for each participant at the various stages of motor development. A time-adjusted injury rate was calculated, rather than relying on count data, due to the fact that infant’s duration in the study differed depending on individual differences in achieving motor milestones. Thus, relying on count data would not explain whether an infant sustained more injuries simply as a result of being in the study longer, or whether their *behaviour* actually led to more injuries across time. Time-adjusting rates are a way to make a fairer comparison between groups with different time distributions. In order to account for this, the injury rate was calculated by using the total frequency of injuries for each participant and dividing it by the number of days the participant was in each motor development stage.

Similarly, in order to examine how parental supervision coincides with risk behaviours during infancy, a risk behaviour rate was calculated for each participant at the various stages of motor development. This rate was calculated by using the total frequency of risk behaviours for each participant and dividing it by the number of days the participant was in each motor development stage.

Data Checking Procedures.

Several preliminary data checking procedures were applied before analyses were conducted, including screening for outliers using Cook’s distance (i.e. >3.3 SD) and checking that variables were normally distributed. Outliers were identified based on standardized Cook’s distance and participants with the greatest Cook’s distance values were removed one by one,

with analyses being re-run each time a new outlier was removed (Howell, 2007). All analyses presented herein contain all possible participants, unless outliers altered the results and needed to be removed. Thus, the number of participants, and therefore the degrees of freedom, may vary across analyses due to the removal of outliers, missing data, or participant attrition.

Before reporting within-participant Analysis of Variance (ANOVA) results, we assessed for violations of sphericity to determine if adjustment to the degrees of freedom was warranted, in which case a Greenhouse-Geisser adjustment was used. Effect sizes are reported as partial eta squared. In conducting multiple paired comparisons, a Bonferroni adjustment for family-wise error rate was applied; the results reported are based on this adjustment having been applied¹.

Before conducting path analyses, preliminary screening was done to check for distribution normality and colinearity. In addition, there was independence of observations and homoscedasticity of residuals. Path analyses were conducted using Mplus Version 7.4 where automated multiple regressions with cross lags were conducted (i.e. influences across parallel processes). Paths in each model were estimated simultaneously.

Results & Discussion

Objective 1: Injury-Risk Behaviours

Who experienced injury-risk behaviours?

Overall, results indicated that 94% of infants' engaged in risk behaviours throughout the course of the study. When examining the frequency of risk behaviours across levels of motor development, results indicated that infants' had more risk behaviours at the crawling stage (67%) in comparison to both sitting (12%) and walking (21%). Interestingly, risk behaviours were

¹ *Note:* the analyses for Minor In-Home Injuries (Objective 2) were run as Repeated Measures MANOVAs with the proportion scores inside each category of motor development in order to obtain the overall omnibus test results and reduce Type 1 error. Given that the omnibus test results were statistically significant; the univariate results were reported for ease of interpretation.

positively correlated across all motor development stages; sit to crawl $r(83) = .38, p < 0.05$, sit to walk, $r(83) = .32, p < 0.05$, crawl to walk, $r(83) = .47, p < 0.05$, indicating that a subset of the same infants' are engaging in risk behaviours over time.

In order to determine how often infants' engaged in the *same* risk behaviour over time, a one way repeated measures ANOVA was conducted with the average times engaged in the behaviour before by motor development level separately, as within-participant factors. The results indicated that infants' engaged in the same risk behaviour significantly more during the crawling stage of development ($M = 2.33, SD = 1.79$) compared to both sitting ($M = 0.74, SD = 1.66$) and walking ($M = .99, SD = 2.07$), $F(2, 142) = 15.11, p < 0.05, \eta_p^2 = .16$. Thus, these data indicate that crawling is the greatest injury-risk stage of motor development; infants' are not only engaging in the *most* risk behaviours compared to other developmental stages, they are also engaging in the *same type* of risk behaviours over time.

Parent beliefs regarding injury-risk behaviours to infants':

In order to measure a range of different parental beliefs regarding injury-risk behaviours, caregivers were asked to answer several questions using a 5 point Likert scale (1 = *not at all*, 5 = *very*). To explore whether parental beliefs differed by motor developmental level, a series of one-way repeated measures ANOVAs were conducted with parent responses by motor development level as within-participant factors.

When looking at parental beliefs, some significant differences emerged as a function of the child's motor development level. Results indicated that parents were more surprised by the risk behaviour at the sitting stage of development ($M = 2.86, SD = 0.70$) compared to both crawling ($M = 2.39, SD = 0.95$) and walking ($M = 2.34, SD = 0.78$), $F(2, 130) = 9.03, p < 0.05$,

$\eta_p^2 = .12$. Similarly, when examining the likelihood that this behaviour would occur again, results indicated that parents thought infants' at the sitting stage of development were significantly more likely to engage in this behaviour again ($M = 4.77, SD = 0.77$) compared to both crawling ($M = 4.50, SD = 0.65$) and walking ($M = 4.23, SD = 0.52$), $F(2, 130) = 11.79, p < 0.05, \eta_p^2 = .15$.

When examining how much parents believe they can prevent these types of risk behaviours, results revealed that there was not a significant difference across motor development level, $F(2, 130) = .581, p = .561, \eta_p^2 = .009$. Thus, parents consistently agreed that they can help to prevent risk behaviours a fair amount across all stages of development.

In order to understand how parents' believed they could help to prevent risk behaviours across development, some follow-up questions were explored. Results indicated that parents believed children understood the danger of the behaviour significantly greater at the walking stage of development ($M = 1.99, SD = 0.74$) compared to both sitting ($M = 1.18, SD = 0.26$) and crawling ($M = 1.36, SD = 0.52$), $F(2, 130) = 60.75, p < 0.05, \eta_p^2 = .48$. Additionally, as expected, parents believed that children understood that they should not engage in risk behaviour significantly greater at the walking stage ($M = 2.08, SD = 0.07$) compared to sitting ($M = 1.31, SD = 0.03$) and crawling ($M = 1.62, SD = 0.08$), $F(2, 130) = 40.38, p < 0.05, \eta_p^2 = .383$.

Interestingly, results revealed that parents believed closer supervision could have prevented risk behaviours significantly more at the crawling stage of development ($M = 3.17, SD = 0.85$) compared to the walking ($M = 2.81, SD = 0.88$), $F(2, 130) = 4.27, p < 0.05, \eta_p^2 = .06$. However, examining the level of supervision across developmental stages indicated that parents did *not* adjust their supervision patterns accordingly at the crawling stage of development (See Table 1). In fact, parents' average supervision level at crawling stage remained at 'not looking

and not listening closely' which would not be a sufficient level to prevent infant risk-behaviors. Thus, although parents *recognize* that crawling is a high-risk stage of development, they do not actively increase their supervision levels to buffer against such risk. Interestingly, further analyses revealed that parents actually worry about infants' risk behaviours significantly more at the walking stage of development, $F(2, 130) = 6.84, p < 0.05, \eta_p^2 = .09$, thus it may be that as children become increasingly mobile, parents worry more about the *types* of risk behaviours infants' may engage in, given their ability to access a full range of potential hazards in their environment. The increase in parent's supervision level at the walking stage of development ($M = 11.01, SD = 1.51$) would support this notion; however, it should be noted that even parents *highest level of supervision*, 'not looking at the child but listening closely', remains inadequate for actively preventing most risk behaviours in infants'.

Correlations at sitting

Correlations were conducted to determine if parents' beliefs about risk behaviours were related at each level of motor development. Interestingly, results for sitting revealed that how surprised parents were by the risk behaviour their child engaged in was negatively correlated with how much parents believed they can prevent these types of injuries, $r(66) = -.25, p < 0.05$. Thus, the more surprised parents were, the less they felt they could prevent these types of behaviours. Similarly, results indicated that how surprised parents were was negatively correlated with how typical they felt these behaviours were for the child's age [$r(66) = -.36, p < 0.06$], indicating that the more unpredictable the parents felt their child's behaviour was, the less typical they felt it was for their age. Additionally, results indicated that how typical parents felt these behaviours were for this age was significantly positively correlated with how likely parents

believe their child would try this behaviour again, $r(66) = .46, p < 0.05$. Thus, the more typical they felt it was for a child of this age to engage in the risk behaviour, the more likely they were to believe their child would engage in it in the future. Additionally, results indicated that how typical parents felt behaviours were for this age was positively correlated with how much they felt they could prevent these types of behaviour, $r(66) = .45, p < 0.05$. Hence, as these data indicate, the more predictable a parent believes their child's behaviour to be, the more they felt they were able to prevent the risk. As expected, results also indicated that the more parents' worried about their child getting hurt doing these types of things, the more intensely they reacted to the behaviour, $r(66) = .49, p < 0.05$. Further results revealed that how well parents thought their child understood the danger of doing the behaviour is significantly positively correlated with how well they thought their child understood that you do not want them to do this, $r(66) = .76, p < 0.05$.

Correlations at crawling

Similar to the sitting stage, results revealed that how likely parents felt it was that their child would try this behaviour again was positively correlated with how typical parents felt these behaviours were at this age, $r(66) = .52, p < 0.05$. Additionally, how much the parent worries about their child getting hurt from doing this type of risk behaviour was positively correlated with how intensely they reacted to them doing this, $r(66) = .40, p < 0.05$. Lastly, how well parents think their child understood the danger of doing this was significantly positively correlated with how well their child understood that you do not want them to do this, $r(66) = .66, p < 0.05$.

Correlations at walking

At the walking stage of development, results indicated that how surprised parents were by what their child did was negatively correlated with how much parents believed they could prevent these types of behaviour, $r(66) = -.26, p < 0.05$. Additionally, as expected, the more surprised parents were by the risk behaviour, the less typical they felt these behaviours were at this age, $r(66) = -.36, p < 0.05$. Further, how much parents' felt their child would try this behaviour again was positively correlated with how typical they felt these behaviours were, $r(66) = .39, p < 0.05$. Consistent with the other stages of development, results revealed that how much parents' worried about their child getting hurt was positively correlated with how intensely they reacted to the behaviour, $r(66) = .56, p < 0.05$. Lastly, how well parents think their child understood the danger of doing this is significantly positively correlated with how well their child understood that they did not want them to engage in this behaviour again, $r(66) = .63, p < 0.05$.

Parental Supervision at the time of injury-risk behaviours

In order to explore the nature of parental supervision at the time of injury-risk behaviours, descriptive analyses were run on several diary items. Results indicated that mom was the primary supervisor for 87% of risk behaviours reported, followed by dad (12%), and other (1%); a similar pattern emerged across motor development level. When exploring how parents came to know that their child was engaging in a given risk behaviour, 89% indicated that they caught the child in the act whereas 11% indicated that they became aware of the behaviour afterwards. Given the fact that majority of parents indicated they became aware of the risk

behaviour *in the moment*, it was important to examine the factors that led parents to become aware this. Results indicated that 78% of parents saw something, 13% heard something, 7% checked on the child, and 2% indicated that someone alerted them to their child's behaviour. Interestingly, although the majority of parents indicated that they saw the child engage in the behaviour, caregivers also reported about a 2-minute lapse in the last time they laid eyes on their child during risk behaviours. Thus, it may be that this lapse in supervision creates difficulty in preventing the child from not following through with a given risk behaviour. Furthermore, results indicated that infants' engaged in most risk behaviours in the living room (44%), whereas parents indicated that they were mostly in the kitchen at the time of infant's injury-risk behaviours (40%); thus although caregivers may still have their child "in-view" from another location in the house, these data indicate that relying on visual or auditory supervision without the added component of proximity is *not effective* in preventing infants' injury-risk behaviours.

Objective 2: Minor In-Home Injuries

Who experienced minor in-home injuries?

Overall, results indicated that 91% of infants' experienced in-home injuries throughout the course of the study. When examining the frequency of injuries across levels of motor development, results indicated that infants' had more injuries at the crawling stage (62%) in comparison to both sitting (12%) and walking (26%). Interestingly, injuries at crawling were positively correlated with injuries at walking, $r(83) = .52$, $p < 0.05$, suggesting that a subset of the same children are getting injured over time. More importantly, when examining correlations between risk behaviours and injuries sustained, there are positive correlations across sitting $r(83) = .44$, $p < 0.05$, crawling $r(83) = .43$, $p < 0.05$, and walking $r(83) = .50$, $p < 0.05$, indicating that

the same infants' who engage in risk behaviours are those who experience injuries across time.

When did infants' experience minor in-home injuries and what actions led to these outcomes?

To gain a better understanding of when infants' were experiencing injuries, descriptive analyses were conducted on the time of day (morning, afternoon, evening). Results indicated that infants' experience injuries fairly consistently throughout the day, including the morning (37%), followed by evening (35%), then afternoon (28%). The same pattern emerges across motor development.

To determine what child activities led to a higher proportion of injuries, a repeated measures ANOVA was conducted with activity type (4: physically active play, physically active non-play, non-physically active play, inappropriate behaviour²) and motor development (3: sit, crawl, walk) as within-subject factors. Results revealed a significant interaction of activity type x motor development level, $F(3.65, 281) = 6.63, p < 0.05, \eta_p^2 = .08$. To investigate the nature of this interaction further, follow up one-way ANOVAs were conducted.

A series of one-way repeated measures ANOVAs were conducted with activity type (4: physically active play, physically active non-play, non-physically active play, inappropriate behaviour) by motor development level separately (3: sit only, crawl only, walk only) as within-participant factors. As can be seen in Table 2, the proportion of injuries that occurred as a result of physically active non-play were significantly greater than those that occurred due to all other activities. This pattern occurred within all stages of motor development, $F(1.83, 141) = 288.66, p < 0.05, \eta_p^2 = .79, F(2.28, 176) = 91.61, p < 0.05, \eta_p^2 = .54, F(1.62, 125) = 110.35, p < 0.05, \eta_p^2 = .54$.

² Note: *physically active play* = running, jumping, bouncing, kicking a ball, dancing, etc. *Physically active non-play* = climbing on furniture, standing on furniture, opening and closing door, etc. *Non-physically active play* = sitting on the floor playing with toys, playing in bathtub, etc. *Inappropriate behaviour* = something that the parent would have disapproved of, such as opening a safety lock.

= .59, respectively. Thus, these data indicate that within all levels of motor development, infant's injuries typically result from the physical exploration of their environment, rather than play-based behaviour.

In order to determine if the activities that led to injury varied with motor development level, a series of one-way ANOVAs were conducted separately on each type of activity (see Table 2), with motor development level (3) as a within-participants factor. As expected, the results indicated that the proportion of injuries during physically active play were significantly greater during walking stages of development compared to sitting and crawling, $F(1.720, 132) = 10.30, p < 0.05, \eta_p^2 = .118$. When examining the proportion of injuries that occurred during non-physically active play, results revealed that the proportion was significantly greater at sitting than at both crawling and walking stages of development, $F(1.77, 136) = 19.27, p < 0.05, \eta_p^2 = .20$. Results did not yield any significant differences for the proportion of injuries that occurred during physically active-non play activities, $F(1.85, 142) = .24, p = .774, \eta_p^2 = .00$, or inappropriate behaviour, $F(1.57, 121) = 2.33, p = .114, \eta_p^2 = .03$. Thus, as these data indicate, the injuries that infants' sustain largely reflect their current motor capabilities; injuries as a result of active play significantly increase as motor development increases, whereas injuries that occur due to non-physically active play occur primarily at the sitting stage of development.

What types of injuries did infants' sustain in the home?

To determine whether motor capabilities influenced the nature of injuries sustained, a repeated measures ANOVA was conducted with injury type (3: cuts, bumps, other³) and motor development level (3: sit, crawl, walk) as a within-subjects factor. Results revealed a significant

³ Note: *Cuts* include scrapes and punctures. *Bumps* include bruises, crushing, red mark, bite marks and pinch. *Other* includes ingestion related/choking, any of cuts/scrapes/punctures in combination with any bumps/bruises/crushing/red mark

interaction of injury type x motor development level, $F(3.14, 254.17) = 4.49, p < 0.05, \eta_p^2 = .05$. To investigate the nature of this interaction further, follow up one-way ANOVAs were conducted.

A series of one-way ANOVAs were conducted with injury type (3: cuts, bumps, other) by motor development level separately (sit only, crawl only, walk only) as within-participant factors. As indicated in Table 3, the incidence of bumps was significantly greater than cuts and other types of injuries within all motor stages, $F(2, 162) = 524.76, p < 0.05, \eta_p^2 = .87, F(1.80, 146) = 103.86, p < 0.05, \eta_p^2 = .56, F(1.57, 127) = 66.06, p < 0.05, \eta_p^2 = .45$, respectively, and the incidence of cuts significantly exceeded other types of injuries ($p < 0.05$). Thus, as expected, the most common type of injuries that infants' experience across motor development levels are bumps.

In order to see whether any differences emerged between motor development levels, a series of one-way repeated measures ANOVAs were conducted with injury type separately (3: cuts, bumps, other) by motor development level (3: sit, crawl, walk) as within-subject factors.

Results did not yield any significant difference for the proportion of cuts between motor development stages, $F(1.86, 150.25) = 1.68, p = .189, \eta_p^2 = .02$, however, the proportion of bumps were significantly greater at sitting compared to walking, $F(1.92, 155.68) = 5.29, p < 0.05, \eta_p^2 = .06$, and the proportion of other types of injuries were significantly greater at both crawling and walking compared to sitting, $F(1.58, 127.71) = 7.29, p < 0.05, \eta_p^2 = .08$.

Each injury was also coded to indicate the body part affected: 1 = head and neck; 2 = upper limbs; 3 = lower limbs; 4 = torso; 5 = internal; 6 = other. Descriptive analyses revealed that 84% of injuries affected infants' head and neck, followed by upper limbs (10%), lower limbs (4%), and torso (2%). Examination of each motor stage also revealed a similar pattern. Hence,

these data indicate that infants' across all motor stages are likely to engage in behaviours that result in injuries to their head and neck, suggesting that they are at an increased risk for potentially *serious* injuries.

Parent reactions to in-home injuries to infants'

When looking at who felt most responsible for childhood injuries, caregivers indicated that these were mostly attributable to bad luck (43%), followed by mother (26%), child (23%), and 'other' (8%); when examining responsibility of injury by motor development level, the same trend emerges at each stage. Thus, consistent with the literature, many caregivers believe that unintentional injuries are a result of bad luck, rather than being predictable in nature. Interestingly, despite caregivers indicating that majority of injuries were a result of bad luck, 63% reported that infants' had engaged in the *same* behaviour before, with 50% of these resulting in an actual injury; when examining these data across motor development levels, the same pattern emerges. Thus, there is stability in the behaviours that infants' do that lead to injuries, indicating they are predictable, yet infants' continue to get injured in the *same way* across development.

Interestingly, when caregivers were asked if they have done, or plan to do, anything special to decrease the likelihood that their child would get hurt this way again in the future, 61% of caregivers (54% at sitting, 60% at crawling, 68% at walking) indicated that they had already done something. Given the fact that injuries continue to persist across time based on the *same* behaviour, it was important to explore what methods parents had put into place in an attempt to decrease injuries. Results indicated that overall, majority of parents childproofed their environment (51%), followed by using closer supervision (34%), teaching safety rules (10%), and other (5%). The same trend emerged across all motor development levels. Thus, it appears

that caregivers place an emphasis on using childproofing strategies (58% at sit, 49% at crawl, 46% at walk) to decrease infant's injury-risk.

Parent beliefs regarding in-home injuries to infants'

Mothers also used a six-point Likert scale to indicate whether they believed closer supervision could have prevented their child from getting hurt (1 = *disagree completely*, 2 = *disagree moderately*, 3 = *disagree a little*, 4 = *agree a little*, 5 = *agree moderately*, 6 = *agree completely*). Interestingly, caregivers tended to *disagree* with the statement across all levels of motor development. In particular, at sitting, caregivers felt that closer supervision would not at all have prevented the infant from getting hurt ($M = 0.70$, $SD = 1.56$), at crawling caregivers disagreed with the statement a little ($M = 3.07$, $SD = 1.99$), and at walking caregivers disagreed with the statement moderately ($M = 2.16$, $SD = 2.07$). Thus, it makes sense that caregivers emphasize the use of childproofing strategies if they believe closer supervision would not prevent in-home injuries.

Additionally, caregivers were asked to indicate whether they thought it was typical for their child to get hurt in this way (1 = *not typical at all*, 5 = *completely typical*). When infants' were at the sitting stage of motor development, caregivers indicated that they felt it was *not typical* for infants' to get hurt in this way ($M = 1.38$, $SD = 1.84$), whereas at crawling and walking, caregivers felt the injuries were *pretty typical* ($M = 3.29$, $SD = 1.35$, $M = 2.53$, $SD = 1.90$, respectively). Thus, as age and motor development increase, caregivers tend to believe that the injuries infants' are sustaining are fairly typical.

Caregivers were also asked to report how likely they think it is that their child will get hurt in this way again while at home (1 = *not all likely*, 5 = *very likely*). Interestingly, caregivers

reported that they believe infants' at sitting were not at all likely to get hurt this way again ($M = 1.38$, $SD = 1.77$) and that infants' at crawling and walking are somewhat/a bit likely ($M = 3.26$, $SD = 2.03$, $M = 2.33$, $SD = 1.84$, respectively) to get hurt in this way again. Thus, although the results above indicate that majority of infants' have in fact been injured in the same way *previously*, it appears that parents beliefs that it will happen *again in the future* is fairly unlikely, which may be related to their attribution of bad luck.

Parental Supervision at the time of in-home injuries

In order to explore the nature of parental supervision at the time of infant injuries, a repeated measures ANOVA was conducted with parent activity type (4: chore, leisure, with child, ordinary daily task⁴) and motor development level (3: sit, crawl, walk) as within-subject factors. Results revealed a significant interaction effect of activity type x motor development level, $F(4.48, 358.31) = 14.38$ $p < 0.05$, $\eta_p^2 = .15$. To investigate the nature of this interaction further, follow up one-way ANOVAs were conducted.

A series of one-way repeated measures ANOVAs were conducted with activity type (4: chore, leisure, with child, ordinary daily task) as within-participant factor at each motor development level separately (sit only, crawl only, walk only). Results revealed that during the sitting stage of motor development, there was a significantly greater proportion of injuries while the caregiver was doing a leisure activity compared to both chores and an ordinary daily task (see Table 4). Interestingly, there were also significantly greater proportions of injuries that occurred while the caregiver was with the child in comparison to both chores and ordinary daily tasks, $F(2.86, 228.92) = 16.47$, $p < 0.05$, $\eta_p^2 = .17$. At the crawling stage of motor development, results

⁴ Note: *Chores* = doing dishes, laundry, cleaning up, preparing meals, etc. *Leisure* = personal activities such as watching television, reading, on computer, etc. *With child* = doing an activity with the child. *Ordinary* = not chores

revealed that the proportion of injuries were significantly greater while the caregiver was doing chores compared to all other activities. Additionally, the proportion of injuries were significantly greater while the caregiver was doing a leisure activity, and while doing something with the child, compared to an ordinary daily task, $F(2.04, 163.61) = 37.46$ $p < 0.05$, $\eta_p^2 = .32$. At the walking stage of development, results indicated that there were a significantly higher proportion of injuries when the caregiver was doing chores compared to both leisure and ordinary daily activities. Surprisingly, results also revealed that there were a significantly greater proportion of injuries when the caregiver was doing something with the child compared to leisure and ordinary daily activities, $F(1.81, 144.76) = 38.72$, $p < 0.05$, $\eta_p^2 = .33$.

In order to see whether any differences emerged between motor development levels, a series of one-way repeated measures ANOVAs were conducted with each activity type separately and motor development as the within factor.

Results indicated that the proportion of injuries when the caregiver was doing chores is significantly greater at both crawling and walking stages of development compared to sitting (see Table 4), $F(1.94, 155.51) = 25.22$, $p < 0.05$, $\eta_p^2 = .24$. Further, the proportion of injuries when the caregiver was doing something for leisure is significantly greater at sitting compared to both crawling and walking, $F(1.91, 152.82) = 15.86$, $p < 0.05$, $\eta_p^2 = .16$. Results did not yield any significant difference for the proportion of injuries while the caregiver was doing something with the child between motor stages, $F(1.98, 158.65) = 1.88$, $p = .156$, $\eta_p^2 = .023$, however, the proportion of injuries that occurred while the caregiver was doing an ordinary daily activity was significantly greater at sitting compared to both crawling and walking, $F(1.81, 144.96) = 17.197$, $p < 0.05$, $\eta_p^2 = .18$. Further comparisons also revealed that the proportion of injuries during ordinary tasks was significantly greater at walking compared to crawling (see Table 4).

Objective 3: Relationship Between Injury-Risk Behaviours, Minor In-Home Injuries and Parental Supervision

Overall Supervision: How much time are Infants' Supervised at Home and by Whom?

Results revealed that most of the time infants' were supervised in some fashion, although approximately 4% of time they were left unsupervised⁵. Interestingly, when examining motor development level, results indicated that caregivers left their infant unsupervised more often during the crawling stage of development (2%) compared to both sitting (1.4%) and walking (0.6%). When examining how caregivers typically supervise in their home, results indicated that infants' were more often in view of their supervisors (65%) than out of view (35%), and that infants' at the crawling stage of development (16%) were more often out of view of their supervisors compared to both sitting (11%) and crawling (8%). Further results indicated that during both in view and out of view entries, infants' were supervised mostly by their mother (81% in view, 92% out of view), with the same pattern emerging across motor stages.

Is there a bi-directional relationship between injury-risk behaviour and injuries sustained?

Using a path analysis, a model was created to determine if risk behaviours predicted injury rate both within a given motor development stage (i.e. risk behaviour at sitting predicting injury rate at sitting) and across motor development (i.e. risk behaviour at sitting predicts injury rate at crawling). Additionally, the model tested whether injury rate predicted risk behaviour across motor development (see Model 1). Results revealed that risk behaviour significantly predicted injury rate both within and across motor development levels (See Table 5). The results also indicated that injury rate significantly predicted risk behaviour across motor development. Thus, as these data indicate, there is a bi-directional relationship between risk behaviours and

⁵ *Unsupervised* was defined as the caregiver not listening to or watching what the child was doing at all (e.g., "don't have to monitor child because he/she knows how to behave") and was not engaging in any intermittent checking.

injury rate, such that the more risk behaviours infants' engage in, the more injuries they experience. Similarly, the more injuries children experience, the more likely they are to engage in risk behaviours.

Does supervision moderate the relationship between injury-risk behaviour and injuries sustained?

Using a path analysis, a model was created to determine if supervision moderated the relationship between risk behaviour and injury-rate at each motor stage (see Model 2). The results revealed that supervision did not act as a moderator in this sample. Both risk behaviour and supervision significantly predicted injury rate at the sitting stage, whereas risk behaviour predicted injury rate at crawling, and no significant results were yielded for risk behaviour or supervision at walking (See Table 6). When combined to create a third variable, the relationship between the interaction term and outcome was non-significant across all levels of motor development. Thus, supervision does not change the strength/direction of the relationship between risk behaviour and injuries within a given motor stage.

General Discussion

Unintentional injuries are the leading cause of pediatric mortality, with preventable injuries killing more Canadian children than any other single disease (Parachute, 2016; Statistics Canada, 2012). When examining infants' specifically, research has identified that majority of unintentional injuries occur in and around the home, when infants' are presumably being monitored by a responsible caregiver (Morrongiello et al., 2005; National Safety Council, 1991; Rivara, Calonge, & Thompson, 1989). Although families' homes are often thought of as the safest place for children to learn and grow, infants' remain particularly vulnerable to this environment due to its physical makeup (e.g., heights, space, structures, furniture) which creates

potential risk hazards and their inability to understand dangerous situations and consequences for their actions (Brownell, Zerwasm, & Ramani, 2007). As a direct result, more than 20,000 young children are seen in the emergency department yearly for injuries that occur in the home, which indicates that approximately 60 young children suffer from injuries that are serious enough to be taken to the hospital every single day (Parachute, 2016). Shockingly, when examining differences by age, results indicate that rates for non-fatal injuries are highest among one-four year olds and that fatal unintentional injuries are the most common among infants' (Child Trends, 2016; Parachute, 2016). Thus, it is evident that unintentional injury poses a significant health threat to young children, especially those under the age of 2 who are unable to understand complex concepts such as causality, which significantly impacts their ability to appraise the risk and danger of a given situation.

Given infants' cognitive immaturity and their inability to accurately judge the components that are involved in a particular injury-risk situation (i.e. danger, risk, and potential severity), caregivers must assume the role of actively implementing precautions to prevent injuries. Although there has been research devoted to understanding parental safety precautions to children 2 years and older, and there is literature to suggest that parental supervision is an important determinant for childhood injury (Morrongiello et al., 2004a; Morrongiello et al., 2004b; Morrongiello et al., 2009), there is virtually nothing known about the nature and scope of parental supervision infants' receive in the home, and surprisingly little is known about the nature of injury-risk behaviours during infancy and how parents become alert to these.

Indeed, previous research has identified peaks in different types of injuries that occur in synchrony with the acquisition of motor skills (Agran et al., 2003), however how parents *respond* and *adjust* to ongoing changes in infant's abilities has been overlooked in the

supervision literature. This is surprising given the fact that this developmental time period can be especially challenging for parents; not only must caregivers be able to accurately predict their children's next behavioural milestone, they must also take into account the individual variabilities of when certain capabilities may emerge and adjust safety precautions accordingly. Hence, this study was important not only for examining how caregiver supervision practices change as infants' gain greater mobility, but to explore whether child characteristics (e.g., developmental level) and parent characteristics (e.g., supervision practices) interact synergistically with infant's risk behaviours and injury outcomes. Given that this study was not hypothesis driven and was exploratory in nature, it provided us with important base line information that is essential to advance our understanding of how often infants' engage in injury-risk behaviours, where and how injuries are typically sustained in the home, and how motor development interacts to create risks throughout infancy. Importantly, this study also allowed us to distinguish those patterns of supervision that regularly occur in the home, what developmental factors influence supervision decisions, and determine supervision factors that are associated with fewer injuries during infancy. Thus, this study is novel in that it allowed us to capture the complexity of interactive child-parent processes that impact supervision patterns and, ultimately, infants' risk taking and injury outcomes. To the best of my knowledge, this is the first study to provide such imperative information.

Contextual Analysis of Risk Behaviours and Unintentional Injuries

Previous research has identified that risk behaviour is associated with unintentional injuries experienced in older children (See Morrongiello et al., 2006 for a review), and that certain child factors (i.e., age, values, personal motivations, personality) increase such risk (Schwebel & Gaines, 2007; Wells, Morrongiello, & Kane, 2012). Given that many of the child

factors that contribute to injury-risk behaviour in older children and youth do not routinely apply to infancy, the present study makes a significant contribution to the literature by showing that infants' *developmental competencies* influence such risk. In the present sample, risk taking behaviour was positively correlated with injuries across all levels of development, indicating that it is the same children who engage in risk taking behaviours that experience injuries across time. Importantly, although how infants' engage in a given behaviour differs across development (e.g., more rolling at the sitting stage, more climbing at the crawling stage, more pushing at the walking stage), our results suggest that there is *stability* in infant's behaviours that lead to injuries. Thus, although infants' utilize different skills across development to engage in a given risk behaviour, results indicated that majority of infants' engaged in the *same* behaviour previously with an astounding 50% of these leading to injury outcomes.

Interestingly, while developmental research suggests that children's risk to injury increases as they age (Towner, Dowswell, Errington & Burkes, 2005) our results indicate that it is actually the stage associated with the greatest *transition* to mobility that creates the greatest risk for infants', in particular 67% of infants' at the crawling stage engaged in risk behaviours and 62% experienced injuries. Thus, although it is true that as children age they have more potential to interact with household hazards, it appears that managing the transition from being pre-mobile (e.g., sitting and exploring primarily through touch) to independently mobile (e.g., using coordination of limbs and movement to explore the environment) is particularly challenging for infants'. Furthermore, although independent mobility allows infants' to interact with hazards in a qualitatively different way, research has identified that young children often overestimate their physical abilities (e.g., children who believe they can reach and step further than they can) and inaccurately judge the size of their body (e.g., trying to fit through spaces that

are too narrow) when exploring the environment (Longobardi, Quaglia & Settanni, 2016; Morrongiello et al., 2007; Schewbel et al., 2007). Thus, as seen in this sample, the errors in self-awareness related to their body and environment can lead to unintentional household injuries. Hence, traditional injury research that has examined age differences alone results in missing valuable development-sensitive information, including the variation in injury-risk across motor competencies that our study captured.

It is of interest to note that across all levels of motor development, infants' experienced the greatest injuries while engaging in physically active non-play behaviour. This is an important finding because it suggests that infants' injuries tend to result from the physical exploration of their environment, rather than play-based behaviour. Although exploration is advantageous in developmental terms, it is evident that it exposes children to potential dangers when adequate safety precautions are not put in place. In fact, our research identified that 84% of injuries affected infants' head and neck, indicating that they are at risk for potentially very *serious* injuries. While the majority of injuries to infants' in this study could be classified as relatively minor (e.g., bumps and bruises, cuts, and punctures), injuries to the head remain a particular concern during infancy given that their skulls are malleable which increases their risk of fracture and intracranial injury (Pickett, Streight, Simpson, & Bruson, 2003; Duhaime, Alario, & Lewander, 1992).

Factors Affecting Infant Injury Risk

There were a number of child characteristics that were correlated with parents' beliefs about injury-risk that warrant attention. In particular, across all levels of motor development results indicated that how typical parents felt risk behaviours were at this age was positively correlated with how likely parents believed their child would try this behaviour again, and

furthermore, how much they felt they could prevent these types of behaviour. This is an important finding because it indicates that the more typical parents find risk behaviours to be, the more likely they feel that they can actively prevent a risk behaviour from occurring. Ironically, even though parents suggest that they could prevent *predictable* behaviours, our results indicated that infants' were engaging in the *same* risk behaviours *across* time. Thus, despite the fact that infants' are demonstrating predictable behaviours and stability in these behaviours across time, parents are not adjusting safety precautions accordingly to prevent injuries from occurring. Indeed, previous research has identified that many caregivers perceive injuries to be accidental or a normal result of childhood behaviour (Morrongiello & Dayler, 1996; Safe Kids Canada, 2006; World Health Organization, 2010) rather than being preventable in nature. Thus, if caregivers attribute childhood injuries to be a natural part of development, it is unlikely that this alone will impact their prevention strategies. Consistent with this, the present study revealed that majority of caregivers attributed infant's injuries to bad luck and not surprisingly, caregivers tended to disagree with the statement that closer supervision could have prevented their child from getting hurt. Thus, if parents believe that their infants' behaviour is highly predictable this may explain why they feel infants' risk of injury is low and therefore explain why they engage in lower levels of supervision.

Interestingly, when examining motor development separately, caregivers *recognized* that crawling was a high risk stage of development and indicated that closer supervision could have prevented risk behaviours at *this* stage; however, when examining caregiver's supervision levels across development, results indicated that parents did *not* adjust their supervision patterns accordingly. In fact, results indicated that caregivers did not change their level of supervision

from the sitting to crawling stage of development (i.e., both remained at ‘not looking at the child and not listening closely’) even though they recognized crawling to be a problematic stage.

Previous research has identified that the more anxious or worried parents are about children’s safety, the more likely they are to implement strategies to keep their children safe (Cordovil, Araujo, Pepping, & Barreiros, 2015; Morrongiello, 2005; Morrongiello et al., 2009). Interestingly, the results of this study indicated that parents worried significantly more about infant’s risk behaviours at the walking stage of development and thus increased their level of supervision at this motor stage. It may be, therefore, that parents perceive the phase of independent locomotion to be particularly dangerous for children and are thus more willing to implement strategies that will reduce injury-risk. There has been some research which suggests that infants’ mobility level is associated with a change in maternal behaviour and feelings of connectedness to the infant (Phelps, Ling & Carrasco, 2006; Kretch, Franchak & Adolph, 2014); thus from an attachment paradigm, it may be that the way caregivers *interact* with children who are independently mobile influences the way they perceive safety and injury-risk to their infant.

Supervision and Injury-Risk

Research with older children has identified particular time points when injuries are most common. For example, Morrongiello and colleagues (2004a) found that injuries to preschool children occurred more frequently in the morning than any other time of the day. Interestingly, in the present sample, injuries occurred fairly consistently throughout the morning, afternoon and evening. Thus, this presents an additional challenge for parents in that they need to provide *ongoing* injury prevention strategies throughout the day. In part, this may explain why caregivers in this sample tended to rely on childproofing strategies to prevent childhood injuries more than any other method. Although we acknowledge that constant ongoing supervision is not possible at

every minute of the day, the results in both the present study and previous research have identified that relying solely on one prevention method (e.g., environmental modifications, teaching) is not effective in preventing injury-risk to children (Morrongiello et al., 2004b). In fact, this was evident in the current sample given that nearly three quarters of infants' continued to get injured in the same way across development, despite the fact that 63% of parent's report utilizing environmental modifications. Hence, these findings suggest that using childproofing strategies on their own are not effective in preventing injuries to infants' and that it can actually be associated with more frequent injuries. This makes sense given infancy is a developmental process marked by continuous change, thus, although environmental modifications may work to manage risk at one stage of development, the same modification may actually become a hazard at another stage of development (e.g., stair gates may work at the crawling stage but can become a hazard when infants' learn to climb; Flavin, Dostaler, Simpson, Brison, & Pickett, 2006). Furthermore, research has consistently indicated that when parents provide higher levels of supervision, children experience lower levels of injuries (Morrongiello, Kane, Bell, 2011; Morrongiello, Kane, Zdzieborski, 2011; Morrongiello et al., 2009; Schwebel & Bounds, 2003). It is interesting to note that even though caregivers in this sample *believed* closer supervision would not prevent injuries from occurring, the results indicated that when parents *did* increase their level of supervision, this was associated with fewer injuries sustained. Thus, during infancy when developmental milestones are transitioning, integrating active supervision *with* environmental modifications proves to be effective in reducing unintentional injuries. The necessary inclusion of *active* supervision (e.g., auditory/visual attention, continuity in watching and proximity to infant) provides caregivers with the ability to intervene quickly if a child is interacting with hazards that parents didn't previously anticipate would pose such risk. It is

important to note, however, that when parents do not incorporate all 3 dimensions of supervision (see above) and rely on just one aspect (e.g., visual or auditory) without the added component of proximity, the level of supervision remains *insufficient* to decrease injury-risk to infants', as evidenced in this study.

Relationship Between Injury-Risk Behaviours, Unintentional Injuries and Parental Supervision

Infancy is a unique developmental period, given that someone is always providing direct care and can be thought of as the responsible authority associated with an injury event. While the present study indicated specific *types* of supervision that lead to more injury-risk behaviours (e.g., out of view, or relying on either visual or auditory supervision alone) and certain parental *beliefs* that impacted supervision patterns (e.g., predictability of behaviour, the level of concern or worry associated with a particular milestone), it also yielded some unexpected results that warrant further discussion. In particular, our results indicated that caregiver supervision level did not moderate the relationship between injury-risk behaviours and unintentional injuries experienced in the home. Several hypotheses are considered regarding this finding. First, our results indicated that caregivers did not adjust their supervision levels significantly across motor development levels. In particular, parents maintained lower levels of supervision fairly consistently throughout all motor stages. Thus, given that there was limited range and variability in caregiver's overall supervision scores, it seems plausible that supervision did not moderate the relationship between risk behaviour and injuries. Based on previous literature, one would postulate that higher levels of *active* supervision, such as "looking at him/her intermittently but still within view" or "have him/her within constant view and proximity" would have a moderating effect on this relationship (Morrongiello et al., 2004a; Morrongiello, 2005). Hence, it

could be that our sample did not exhibit high enough levels of supervision to *significantly* impact the relationship between risk behaviour and unintentional injuries. Secondly, given that our measure of supervision is based on parent perception of what appropriate supervision was during a particular injury-risk event, it is possible that there are other contributing factors that influence this perception that were not accounted for in this model. As shown in Figure 1, it may be that infants' risk taking is a multi-determined outcome, with additional child and parent factors that influence this behaviour. While motor competencies are clearly an important child factor that influences supervision, as evidenced in this study, it may be that more individual child characteristics (e.g., gender, temperament, activity level, behaviour) and parent factors (e.g., mental health, parenting style, siblings) need to be explored to determine how these interact to influence supervision levels during infancy. Indeed, previous research with older populations has found that children high in sensation seeking, impulsiveness, and thrill-seeking behaviours engage in greater risk taking and experience more injuries (See Morrongiello et al., 2006; Schewbel et al., 2007 for review). Thus, it could be that during infancy, child-attributes (e.g., behavioural intensity, activity level) determine how much, or how little, parents need to supervise to manage such risks. Lastly, given the fact that there is ample research to suggest that supervision is an important risk-reducing method in older populations (Morrongiello et al., 2009; Morrongiello, Kane, Bell, 2011; Morrongiello, Kane, Zdzieborski, 2011; Schwebel & Bounds, 2003), and there have been successful interventions related to supervision and injury-risk (Morrongiello, Zdzieborski, Sandomierski, & Munroe, 2013; Peterson, DiLillo, Lewis, & Sher, 2002), there is no reason to believe that supervision would not be effective with this age group. Thus, future research is needed to determine what behavioural factors interact to influence

supervision levels during infancy.

Limitations and Directions for Future Research

Although this study provided numerous insights into injury-risk behaviours, in-home injuries, and parental supervision patterns of infants', there are several limitations that merit consideration for future research on this topic. First, our sample size (N = 83) was relatively small for conducting path analyses with the number of parameters used. According to several researchers (Klein, 1998; Streiner, 2005) an adequate sample size for path analysis should be between 10-20 times the amount of the parameters used in the model. Thus, the sample size used in this study could have affected the results obtained. Second, given the objective of the study was to examine how these processes *change* across development, a better option would be to model the data as a growth curve rather than using repeated-measures ANOVA. Although sample size restrictions did not permit us to utilize this statistical technique, future research should consider using growth curve modelling (GCM) to measure change in parental supervision, injury-risk behaviours, and injuries at both the population *and* individual levels across time. Secondly, parenting experience was not considered in this study; however, it could be that first time mothers show different supervision patterns than those with multiple children, therefore, future research should consider whether prior experience with parenting impacts supervision patterns. Additionally, only mothers were included as caregivers in this sample, thus, we are unaware if mothers and fathers differentially supervise during infancy. Future research should extend to study these processes in fathers in order to understand what factors influence their supervisory patterns. Next, it should be noted that given this study required a tremendous amount of work and commitment from participants, it is possible that those who completed the study are not representative of the more general population. Indeed, the generalizability of this

study is constrained by the demographics in this sample; most caregivers were Caucasian, well-educated, and had moderate to high incomes. Thus, it's possible that the supervision patterns obtained in this sample are not reflective of the broader population of parents of infants'. Future research should aim to obtain a more diverse population, and this issue may be addressed by utilizing less burdensome measures (e.g., the use of Qualtrix on a hand-held device would make this process easier). Lastly, an important limitation to acknowledge is that because this study relied on self-report data, it is possible that participants falsely reported more desirable responses due to demand characteristics or fear of value judgement. Although every effort was made to establish rapport with participants and emphasize that no child could be supervised at all times, it is possible that simply being involved in a study examining supervision patterns made participants more vigilant about their supervisory behaviour and impacted the results. Future research should incorporate an observational component to further confirm the validity of diary measures.

Conclusions

The current study employed a multi-method approach to studying supervision and injury during infancy. The findings provide numerous insights into infants' injury-risk behaviours, injuries experienced in the home, and parents' typical prevention methods. Although there have been numerous studies that have examined injury-risk in older children, this study is the first to explore how child factors and parent factors interact to create risk during infancy. The major goal of this research was not only to examine *what* parents do in response to infant risk behaviours, but understanding *why* they do so.

Indeed, this research determined that infants' risk behaviour is *predictable* and *stable* across development, however, parents' current safety precautions (e.g., environmental

modification) remains insufficient to manage this risk. This study identified that parental beliefs about predictability and typicality influence their decisions regarding safety precautions, such that, the more predictable they believe their infants' behaviour is, the more likely they think they will be able to actively intervene. Interestingly, the results indicated that caregivers often fail to anticipate when a given behaviour will occur and thus do not adjust their safety precautions accordingly.

Although environmental modifications may be a more convenient safety precaution to implement in comparison to other effortful practices (e.g., continuous supervision), the extent to which an environmental modification approach is effective depends on how accurately parents can identify hazards for infants' *across* motor stages. It is unlikely for example, that the hazards that are relevant during the sitting stage will be the only hazards applicable at the crawling stage of development. In fact, given that motor development is not always a linear process and there is marked intra-variability among infants' (e.g., stages occur in differing orders for different infants'), parents must be able to simultaneously anticipate *their* child's individual skill set while adjusting their safety practices accordingly.

It is promising, however, that when parents do increase their level of supervision, infants' experience a decrease in injury occurrences. Thus, consistent with previous findings, the most reliable strategy for preventing injuries is *active supervision* that involves continuity in watching and proximity to ensure readiness to intervene quickly when needed. Notably, more research is needed in order to examine why parents in this sample had consistently lower levels of supervision across time and what other contributing factors interact to influence these levels (e.g., temperament, gender, siblings, etc.). However, this study has provided important base line

information that is needed to understand how developmental competencies, rather than age, impact injury-risk across infancy.

References

- Agran, P. F., Winn, D., Anderson, C., Trent, R., & Walton-Haynes, L. (2001). Rates of pediatric and adolescent injuries by year of age. *Pediatrics*, *108*(3), E45.
- Agran, P., Anderson, C., Winn, D., Trent, R., Walton-Haynes, L., & Thayer, S. (2003). Rates of pediatric injuries by 3-month intervals for children 0 to 3 years of age. *Pediatrics*, *111*(6), e683-92.
- Allard, D., Campbell, J., Collette, M., Gupta, N., Merrithew, G., Oakley, H., Black, S., Broom, B., Dugas, J., Gorman, H., Hebert, A., Hogan, A., Olmstead, S., Rauska, A., Van Den Hoonarrd, D., Walker, B., & Watson, I. (2012). *A framework for the prevention of unintentional injury in New Brunswick*. Fredricton: NB.
- Anderson, R., Minino, A., Fingerhut, L., Warne, M., & Heinen, M. (2004). Deaths: Injuries, 2001. *National Vital Statistics Reports*, *52*(21), 1-86.
- Babul, S., Olsen, L., Janssen, P., McIntee, P., & Raina, P. (2007). A randomized trial to assess the effectiveness of an infant home safety programme. *International Journal of Injury*, *14* (2), 109-117.
- Bach, O., Hope, M., Chaheka, C., & Dzimbiri, K. (2004). Disability can be avoided after open fractures in Africa: results from Malawi. *Injury*. *35*, 846-851.
- Bayley, N. (2006). Bayley Scales of Infant and Toddler Development – Third Edition. *Journal of Psychoeducational Assessment*, *25*(2), 180-198.
- Berger, S., Theuring, C., & Adolph, K. (2007). How and when infants' learn to climb stairs. *Journal of Infant Behavior and Development*, *30*, 36-49.
- Borse, N., Gilchrist, J., Dellinger, M., Rudd, R., Ballesteros, M., & Sleet., D. (2009). CDC childhood injury report: Patterns of unintentional injuries among 0- to 19-year olds in the united states, 2000-2006. *Family & Community Health*, *32*(2), 189.

- Brownell C. A., Zerwas S., Ramani G. B. (2007). "So big": the development of body self-awareness in toddlers. *Child Dev.* 78 1426–1440.
- Canadian Institute for Health Information. (1994). *Hospital Morbidity Database, 1999-2003*.
- Centre for Disease Control and Prevention, National Center for Injury Prevention and Control. (2012). *Protect the ones you love: Child injuries are preventable*. Retrieved from: <http://www.cdc.gov/safechild/NAP/background.html>
- Chandran A, Hyder AA, Peek-Asa C. The global burden of unintentional injuries and an agenda for progress. *Epidemiol Rev.* 2010; 32:110–120.
- Chen, Y., Mo, F., Yi, Q.L., Jiang, Y., & Mao, Y. (2013). Unintentional injury mortality and external causes in Canada from 2001 to 2007. *Chronic Diseases and Injuries in Canada*, 33(2), 95-102.
- Child Trends. (2016). *Unintentional Injuries*. Bethesda: Maryland.
- Cordovil R., Araújo D., Pepping G. J., Barreiros J. (2015). An ecological stance on risk and save behaviors in children: the role of affordances and emergent behaviors. *New Ideas Psychol.* 36 50–59.
- Dal Santo, J., Goodman, R., Glik, D., & Jackson, K. (2004). Childhood unintentional injuries: Factors predicting injury risk among preschoolers. *Journal of Pediatric Psychology*, 29(4), 273-283. doi:10.1093/jpepsy/jsh029
- Damashek, A. (2014). *Journal of Early Childhood Research*, 12(1), 50-63.
- Dowd, M. D., Keenan, H. T., & Bratton, S. L. (2002). Epidemiology and prevention of childhood injuries. *Critical Care Medicine*, 11, 5385–5392 (Suppl.).

- Duhaime AC, Alario AJ, Lewander WJ, et al. Head injury in very young children: mechanisms, injury types, and ophthalmologic findings in 100 hospitalized patients younger than 2 years of age. *Pediatrics*.1992;90 :179– 185
- Finney, J., Christophersen, E., Friman, P., Kalnins, I., Maddux, J., Peterson, L., Roberts, M., & Wolraich, M. (1993). Society of pediatric psychology task force report: Pediatric psychology and injury control. *Journal of Pediatric Psychology, 18*, 499-526.
- Flavin, M., Dostaler, S., Kelly, S., Brison, R., & Pickett, W. (2006). Stages of development and injury patterns in the early years: A population-based analysis. *BMC Public Health, 6*(1) doi:10.1186/1471-2458-6-187
- Frankenburg, W. K., Camp, B. W., & van Natta, P. A. (1971). Validity of the Denver Developmental Screening Test. *Child Development, 42*(2), 475-485.
- Fuselli, P., Groff, P., Nesdale-Tucker, R., Waldie, R., & Wanounou, A. (2011). The financial costs, and prevention strategies of unintentional injuries. *Public Sector Digest*. Retrieved from: <http://www.publicsectordigest.com/articles/view/804>.
- Gaines, J., & Schwebel, D. (2009). Recognition of home injury risks by novice parents of toddlers. *Accident Analysis and Prevention, 41*(5), 1070-1074.
- Gärling, A., & Garling, T. (1995). Mothers' anticipation and prevention of unintentional injury to young children in the home. *Journal of Pediatric Psychology, 20*(1), 23.
- Garzon, D., Lee, R., & Homan, S. (2007). There's no place like home: A preliminary study of toddler unintentional injury. *Journal of Pediatric Nursing, 22*(5), 368-375.
- Gollenberg, A.L., Lynch, C.D., Jackson, L.W., McGuinness, B.M., & Msall, M.E. (2009). Concurrent validity of the parent-completed Ages and Stages Questionnaires, with the

Bayley Scales of Infant Development II in a low-risk sample. *Child: care, health and development*, 36(4), 485-490.

Grossman, D.C. (2000). The history of injury control and the epidemiology of child and adolescent injuries. *Unintentional Injuries in Childhood*, 10(1), 23-52

Guilfoyle, S. (2012). Supervision to prevent childhood unintentional injury. *Journal of Child Health Care*, 16(2), 141-152. doi:10.1177/1367493511423855

Hammig, B. J., & Ogletree, R. J. (2006). Burn injuries among infants' and toddlers in the United States, 1997-2002. *American Journal of Health Behavior*, 30(3), 259-267.

Hendrickson, S. (2008). Maternal worries, home safety behaviors, and perceived difficulties. *Journal of Nursing Scholarship*, 40(2), 137-143.

Hillier LM, Morongiello BA. (1998). Age and gender differences in school-age children's appraisals of injury risk. *Journal of Pediatric Psychology*, 1998;23:229-238.

Hruschka, D. J., Schwartz, D., John, D. C. S., Picone-Decaro, E., Jenkins, R. A., & Carey, J.W. (2004). Reliability in coding open-ended data: Lessons learned from HIV behavioral research. *Field Methods*, 16(3), 307-331.

Hyder, A., Sugerman, D.E., Puvanachandra, P., Razzak, J., El-Sayed, H., Isaza, A., Rahman, F., & Peden, M. (2009). Global childhood unintentional injury surveillance in four cities in developing countries: A pilot study. *Bulletin of World Health Organization*, 87, 345-352. doi: 10.2471/BLT.08.055798.

Klein RB. Principles and practice of structural equation modeling. New York: Guilford; 1998.

Kretch K. S., Franchak J. M., Adolph K. E. (2014). Crawling and walking infants' see the world differently. *Child Dev.* 85 1503-1518.

- Krug EG, Sharma GK, Lozano R. (2000) The global burden of injuries. *Am J Public Health*, 90: 523-6 doi: [10.2105/AJPH.90.4.523](https://doi.org/10.2105/AJPH.90.4.523) pmid: [10754963](https://pubmed.ncbi.nlm.nih.gov/10754963/).
- Longobardi, C., Quaglia, R., & Settanni, M. (2016). The Transition from Crawling to Walking: Can Infants' Elicit an Alteration of Their Parents' Perception? *Frontiers in Psychology*, 7, 836.
- Lyons, R. A., Sander, L. V., Weightman, A. L., Patterson, J., Jones, S. A., Lannon, S., et al. (2003). Modification of the home environment for the reduction of injuries. The Cochran Database for Systemic Review, 4, 1 –28.
- Mack, K., Dellinger, A., & West, B. (2012). Adult opinions about the age at which children can be left home alone, bathe alone, or bike alone: Second injury control and risk survey (ICARIS-2). *Journal of Safety Research*, 43(3), 223.
- Mack, K., Gilchrist, J., & Ballesteros, M. (2007). Unintentional injuries among infants' age 0-12 months. *Journal of Safety Research*, 38(5), 609-12.
- Mack, K., Gilchrist, J., & Ballesteros, M. (2008). Injuries among infants' treated in emergency departments in the united states, 2001-2004. *Pediatrics*, 121(5), 930-7.
doi:10.1542/peds.2007-1731
- Ministry of Health Long –Term Care. (2002). *Injury: Predictable and Preventable*. Retrieved from:http://www.health.gov.on.ca/en/common/ministry/publications/reports/injury_rep02/injury_rep.aspx
- Morrongiello, B. (2005). Caregiver supervision and child-injury risk: I. issues in defining and measuring supervision; II. findings and directions for future research. *Journal of Pediatric Psychology*, 30(7), 536-552. doi:10.1093/jpepsy/jsi041

- Morrongiello, B. A., Corbett, M., & Brison, J. (2009). Identifying predictors of medically-attended injuries to young children: Do child or parent behavioural attributes matter? *Injury Prevention, 15*(4), 220. doi:10.1136/ip.2008.019976
- Morrongiello, B.A., Corbett, M., & Kane, A. (2011). A questionnaire measure that relates to elementary-school children's risk of injury: The Supervision Attributes and Risk Taking Questionnaire (SARTQ). *Injury Prevention, 17*, 189-194.
- Morrongiello, B.A., Corbett, M., McCourt, M., & Johnston, N. (2006a). Understanding unintentional injury-risk in young children I. The nature and scope of caregiver supervision of children at home. *Journal of Pediatric Psychology, 31*, 529-539.
- Morrongiello, B.A., Corbett, M., McCourt, M., & Johnston, N. (2006b). Understanding unintentional injury-risk in young children II. The contribution of caregiver supervision, child attributes, and parent attributes. *Journal of Pediatric Psychology, 31*, 540-551.
- Morrongiello, B. A., & Dayler (1996). A community-based study of parents' knowledge, attitudes, and beliefs related to childhood injuries. *Canadian Journal of Public Health, 87*, 383–388.
- Morrongiello, B.A., Kane, A., & Bell, M. (2011). Advancing our understanding of mothers' safety rules for school-aged children. *Canadian Journal of Public Health, 102*(6), 455+.
- Morrongiello, B.A., Kane, A., & Zdzieborski, D. (2011). "I think he is in his room playing a video game": Parental supervision of elementary school children at home. *Journal of Pediatric Psychology, 36*, 708-717.
- Morrongiello, B., & Kiriakou, S. (2004). Mothers' home-safety practices for preventing six types of childhood injuries: What do they do, and why? *Journal of Pediatric Psychology, 29*(4), 285-97.

Morrongiello, B.A., Klemencic, N., & Corbett, M. (2008). Interactions between child behaviour patterns and parent supervision: Implications for children's risk of unintentional injury.

Child Development, 79, 627-638.

Morrongiello, B.A & Lasenby-lessard, J. (2006). Psychological determinants of risk taking by children: an integrative model and implications for interventions. *Injury*

Prevention, 13(1), 20-25.

Morrongiello, B., Midgett, C., & Shields, R. (2001). Don't run with scissors: Young children's knowledge of home safety rules. *Journal of Pediatric Psychology, 26*(2), 105-115.

Morrongiello, B.A., Ondejko, L., & Littlejohn, A. (2004a). Understanding toddlers' in-home injuries: I. Context, correlates and determinants. *Journal of Pediatric Psychology, 29*, 415-431.

Morrongiello, B.A., Ondejko, L., & Littlejohn, A. (2004b). Understanding toddlers' in-home injuries: II. Examining parental strategies, and their efficacy, for moderating child-injury risk. *Journal of Pediatric Psychology, 29*, 433-446.

Morrongiello, B.A., & Schell, S. (2010). Child injury: The role of supervision in prevention.

American Journal of Lifestyle and Medicine, 4, 65-74.

Morrongiello, B., & Schwebel, D. (2008). Gaps in childhood injury research and prevention: What can developmental scientists contribute? *Child Development Perspectives, 2*(2), 78-84.

Morrongiello, B.A., Schmidt, S., & Colwell, S. (2011). Development of a measure that differentiates domains of risky driving: Youth Domains of Risky Driving Scale. *Accident Analysis and Prevention*.

- Morrongiello, B. A., & Sedore, L. (2005). The influence of child attributes and social-situational context on school-age children's risk-taking behaviors that can lead to injury. *Journal of Applied Developmental Psychology, 26*, 347–361.
- Morrongiello, B.A., Zdzieborski, D., Sandomierski, M., & Munroe, K. (2013). Results of a Randomized Control Trial (RCT) evaluating the efficacy of the *Supervising for Home Safety* program: Impact on mothers' supervision practices. *Accident Analysis & Prevention, 50*, 587-595.
- Munro, S., Niekerk, A., & Seedat, M. (2006). Childhood unintentional injuries: The perceived impact of the environment, lack of supervision and child characteristics. *Child: Care, Health and Development, 32*(3), 269-279.
- National Safety Council. (1991). *Accident facts*. Chicago: National Safety Council.
- Ontario Ministry of Health and Long-Term Care. (2002). *Injury: Predictable and Preventable*. Ottawa, ON: Minister of Industry.
- Overpeck, M., & McLoughlin, E. (1999). Did that injury happen on purpose? Does intent really matter? *Injury Prevention, 5*, 11-12.
- Parachute. (2015). *The Cost of Injury in Canada*. Toronto: ON: Parachute.
- Parachute. (2016). *The Canadian Atlas of Childhood Injury Prevention*. Toronto: ON: Parachute.
- Peterson, L. (1993). Judgments regarding appropriate child supervision to prevent injury: The role of environmental risk and child age. *Child Development, 64*(3), 934-950.
- Peterson, L., Farmer, J., & Kashani, J. (1990). Parental injury prevention endeavors: A function of health beliefs? *Health Psychology, 9*(2), 177-191.
- Peterson, L., & Stern, B. (1997). Family processes and child risk for injury. *Behaviour Research and Therapy, 35*(3), 179-190.

- Phelan, K. J., Khoury, J., Kalkwarf, H., & Lanphear, B. (2005). Residential injuries in U.S. children and adolescents. *Public Health Reports*, 120, 63–70.
- Phelps E. A., Ling S., Carrasco M. (2006). Emotion facilitates perception and potentiates the perceptual benefits of attention. *Psychol. Sci.* 17 292–299.
- Pickett E, Brison RJ, Mackenzie SG. (2000). Youth injury data in the Canadian Hospitals Injury Reporting and Prevention Program: do they represent the Canadian experience? *Inj Prevention*;6 :9–15
- Pickett, W., Streight, S., Simpson, K., & Brison, R. (2003). Injuries experienced by infant children: A population-based epidemiological analysis. *Pediatrics*, 111(4 Pt 1), e365-70.
- Porter, T.R.; Crane, L.A.; Dickinson, L.M.; Gannon, J.; Drisko, J.; DiGuseppi, C. Parent opinions about the appropriate ages at which adult supervision is unnecessary for bathing, street crossing, and bicycling. *Arch. Pediatr. Adolesc. Med.* 2007, 161, 656–662.
- Powell, E., & Tanz R. (2002). Adjusting our view of injury risk: The burden of nonfatal injuries in infancy. *Pediatrics*, 110(4), 792.
- Public Health Agency of Canada. (2006). *Unintentional injury mortality and external causes in Canada from 2001 to 2007*. (Report No. 3, Volume 2). Ottawa, ON: Minister of Industry.
- Reading, R., Langford, I. H., Haynes, R. & Lovett, A. (1999) Accidents to preschool children: comparing family and neighbourhood risk factors. *Social Science* 48, 321–330.
- Reimers, A., & Laflamme, L. (2005). Neighbourhood socio-economic composition and injury risks. *Acta Paediatrica*, 94, 1488-1494.
- Rennie, L., Court-Brown., Charles, M., Jacqueline, Y., Beattie., & Thomas., F. (2007). The epidemiology of fractures in children. *Injury*. 38, 913-923

- Rimsza, M. E., Schackner, R. A., Bowen, K. A., & Marshall, W. (2002). Can child deaths be prevented? The Arizona Child Fatality Review Program experience. *Paediatrics*, 110, 1–7.
- Rivara, F. P., Calonge, N., & Thompson, R. S. (1989). Population-based study of unintentional injury incidence and impact during childhood. *American Journal of Public Health*, 79, 990–994.
- Rosales, P. (2012)., & Jackson Allen, P. (2012). Optimism bias and parental views on unintentional injuries and safety: Improving anticipatory guidance in early childhood. *Pediatric Nursing*, 38(2), 73-9.
- Rowntree, G. (1950). Accidents among children under two years of age in great britain. *The Journal of Hygiene*, 48(3), 323-337. doi:10.1017/S0022172400015096
- Russell, K. M., & Champion, V.L. (1996). Health beliefs and social influence in home safety practices of mothers with preschool children. *Image: The Journal of Nursing Scholarship*, 28(1), 59-64.
- Safe Kids Canada. (2006). *Child & youth unintentional injury: 1994-2003, 10 years in review*. Toronto: ON: Safe Kids Canada.
- Safe Kids Canada. (2010). *About injuries*. Retrieved from <http://www.safekidscanada.ca/Professionals/Safety-Information/About - Injuries/Index.aspx>
- Saluja, G., Brenner, R., Morrongiello, B., Haynie, D., Rivera, M., & Cheng, T. (2004). The role of supervision in child injury risk: Definition, conceptual and measurement issues. *Injury Control and Safety Promotion*, 11(1), 17-22. doi:10.1076/icsp.11.1.17.26310
- Savitsky., Aharonson-Daniel., Lmor., & Giveon.(2007). Variability in pediatric injury patterns by age and ethnic groups in Isreal. *Ethnicity and Health*, 12, 129-139.

- Schnitzer, P.G. Prevention of unintentional childhood injuries. *American Family Physician*, 2006; 74:1864-1869. Retrieved from:
http://apps.who.int/iris/bitstream/10665/112738/1/9789240692671_eng.pdf
- Schonhaut, L., Armijo, I., Schönstedt, M., Alvarez, J., & Cordero, M. (2013). Validity of the ages and stages questionnaires in term and preterm infants'. *Pediatrics*, 131(5), e1468-e1474.
- Schwebel, D., Binder, S., McDermott Sale, J., & Plumert, J. (2003). Is there a link between children's motor abilities and unintentional injuries? *Journal of Safety Research*, 34(2), 135-141.
- Schwebel, D., & Bounds, M. (2003). The role of parents and temperament on children's estimation of physical ability: Links to unintentional injury prevention. *Journal of Pediatric Psychology*, 28(7), 505-516.
- Schwebel, D., & Brezausk., C. (2007). The role of context in risk for pediatric injury: Influences from the home and child care environments. *Merrill - Palmer Quarterly*, 53(1), 105-130.
- Schwebel, D.C & Gaines, J. (2007). Pediatric Unintentional Injury: Behavioral Risk Factors and Implications for Prevention. *Journal of Developmental & Behavioral Pediatrics*, 28(1), 245-254.
- Sewell, K., & Gains, S. (1993). A developmental approach to childhood safety education. *Pediatric Nursing*, 19, 464-466.
- Simpson, J., Turnbull, B., Ardagh, M., & Richardson, S. (2009). Child home injury prevention: Understanding the context of unintentional injuries to preschool children. *International Journal of Injury Control and Safety Promotion*, 16(3), 159-167.
- Smart Risk. (2009). *Home Safety*. Retrieved from <http://www.parachutecanada.org/smartrisk>
- Smart Risk (2006). *The Economic Burden of Injury in Ontario*. Toronto: ON: Smart Risk.

- Statistics Canada. (2012). Leading Causes of Deaths in Canada, 2009, CANSIM Tables 102–0561 and 102–0562.
- Steenkamp, M., & Cripps, R. (2001). *Child injuries due to falls* (Injury Research and Statistics Series, No. 7). Adelaide, Australian Institute of Health and Welfare.
- Streiner, D. (2005). Finding Our Way: An Introduction to Path Analysis. Retrieved July 01, 2016 from <https://ww1.cpa-apc.org/Publications/Archives/CJP/2005/february/streiner.asp>.
- Tercero, F., Andersson, R., Pena, R., Rocha, J., & Castro, N. (2006). The epidemiology of moderate and severe injuries in a Nicaraguan community: a household-based survey. *Public Health, 120*, 106-114.
- Thuen, F. (1992). Preventing childhood accidents in the home: Parental behavior to reduce household hazards. *Scandinavian Journal of Psychology, 33*, 370–377.
- Towner, E., Dowswill, T., Errington, G., & Burkes, M. (2005). Injuries in children aged 0-14 years and inequalities: *A report prepared for the Health Development Agency*. London: Health Development Agency.
- Van Beelen, M., Van Beeck, E., Hertog, P., Beirens, T., & Raat, H. (2013). Correlates of unsupervised bathing of infants': A cross-sectional study. (2013). *International Journal of Environmental Research and Public Health, 10*(3), 856.
- Warrington, S. A., & Wright, M. (2001). Accidents and resulting injuries in premobile infants': Data from the ALSPAC study. *Archives of Disease in Childhood, 85*(2), 104.
- Wells, M., Morrongiello, B.A., & Kane, A. (2012). Unintentional injury risk in school-age children: Examining interrelations between parent and child factors. *Journal of Applied Developmental Psychology, 33*(4), 189-196.

World Health Organization (2008). *World report on child injury prevention*. Geneva: Switzerland:

World Health Organization.

World Health Organization (2010). *Unintentional childhood injuries* [PowerPoint slides]. Retrieved

from: www.who.int/ceh.

Table 1

Average Supervision Level Across Motor Development Stages

Motor Development	Average Supervision Level		
	<i>M</i>	<i>SD</i>	<i>Supervision Level Descriptor</i>
Sit	10.02	.75	Not looking at the child and not listening closely
Crawl	10.15	1.16	Not looking at the child and not listening closely
Walk	11.01	1.51	Not looking at the child but listening closely

Table 2

Injury Occurrences by Infant Activity Type Across Motor Development Stages

Motor Development	Infant Activity Type							
	Physically Active Play		Physically Active Non-Play		Non-Physically Active Play		Inappropriate Behaviour	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Sit	.07	.11	.67	.17	.23	.16	.03	.06
Crawl	.08	.19	.68	.31	.16	.23	.08	.18
Walk	.20	.27	.70	.31	.05	.13	.05	.12

Table 3

Injury Type Across Motor Development Stages

Motor Development	Injury Type					
	Cuts		Bumps		Other	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Sitting	.22	.16	.78	.16	.00	.00
Crawling	.19	.24	.73	.29	.08	.22
Walking	.25	.29	.66	.30	.09	.16

Table 4

Injury Occurrences by Parental Activity Type Across Motor Development Stages

Motor Development	Caregiver Activity Type							
	Chore		Leisure		With Child		Ordinary Task	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Sit	.21	.18	.32	.20	.33	.19	.14	.15
Crawl	.46	.27	.21	.22	.30	.27	.03	.09
Walk	.40	.25	.15	.16	.38	.26	.07	.10

Table 5

Summary of Regression Statistics for Model 1

Path	Summary of Regression Statistics			
	β	SE	t	<i>p</i>
RB1 → INJ1	0.56	0.11	5.21	.000
RB1 → INJ2	0.46	.011	4.09	.000
RB2 → INJ2	0.44	0.12	3.60	.000
RB2 → INJ3	0.24	0.17	1.44	.005
RB3 → INJ3	0.35	0.19	1.89	.005
INJ1 → RB2	0.38	0.11	3.31	.001
INJ2 → RB3	0.41	0.15	2.75	.000

Note: β = standardized beta coefficient, SE = standard error, t = t-statistic, *p* = significance value.
 RB1 = risk behaviour at sitting, RB2 = risk behaviour at crawling, RB3 = risk behaviour at walking. INJ1 = injuries at sitting, INJ2 = injuries at crawling, INJ3 – injuries at walking

Table 6

Summary of Regression Statistics for Model 2

Path	Summary of Regression Statistics			
	β	SE	t	<i>p</i>
RB1 → INJ1	0.55	0.11	5.16	.000
SUP1 → INJ1	-0.27	0.12	-2.17	.003
RB1*SUP1→ INJ1	-0.07	0.10	-0.75	0.45
RB2 → INJ2	0.49	0.11	4.12	.000
SUP2 → INJ2	0.13	0.14	0.90	0.36
RB2*SUP2→ INJ2	0.21	0.12	1.67	0.09
RB3 → INJ3	0.26	0.20	1.29	0.19
SUP3 → INJ3	-1.75	0.24	-0.71	0.47
RB3*SUP3→ INJ3	0.23	0.16	1.37	0.17

Note: β = standardized beta coefficient, SE = standard error, t = t-statistic, *p* = significance value. RB1 = risk behaviour at sitting, RB2 = risk behaviour at crawling, RB3 = risk behaviour at walking. INJ1 = injuries at sitting, INJ2 = injuries at crawling, INJ3 – injuries at walking. SUP1 = supervision at sitting, SUP2 = supervision at crawling, SUP3 = supervision at walking

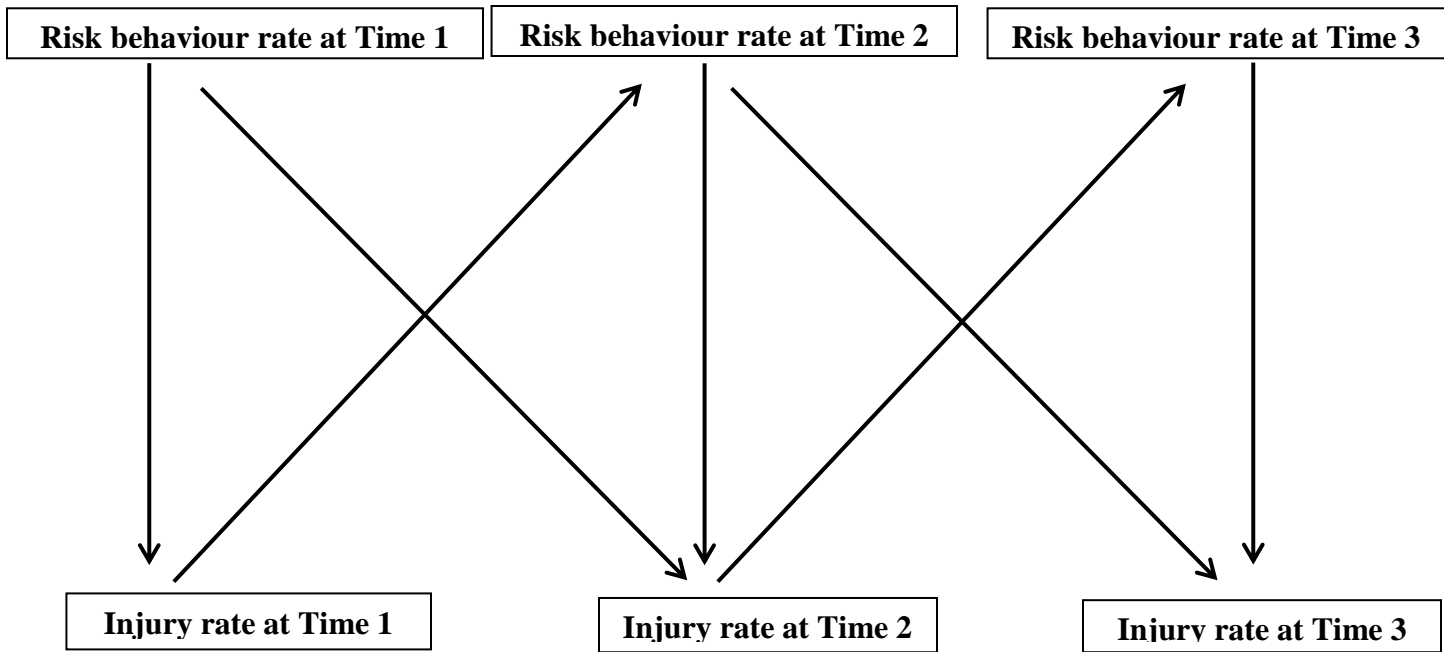


Figure 1. Input path diagram for Model 1 depicting the bi-directional relationship between risk behaviour and injury within and between motor development stages.

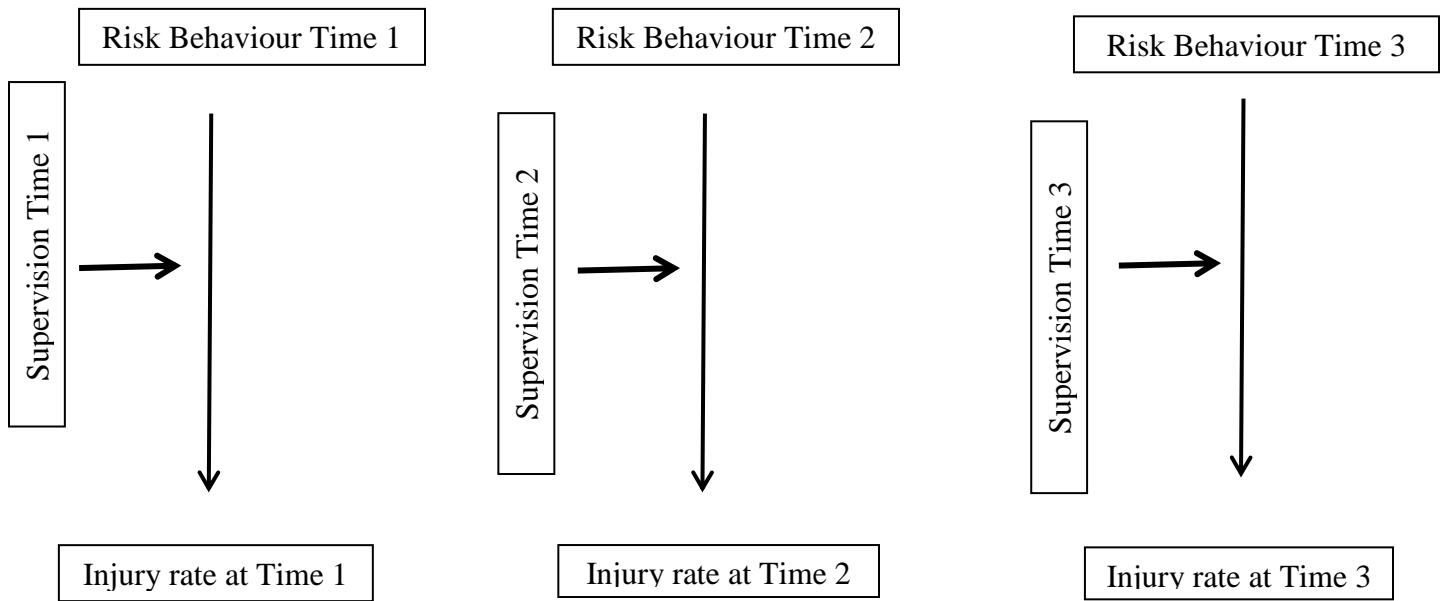


Figure 2. Input path diagram for Model 2 depicting the moderating relationship between risk behaviour and injury occurrences within each motor stage.

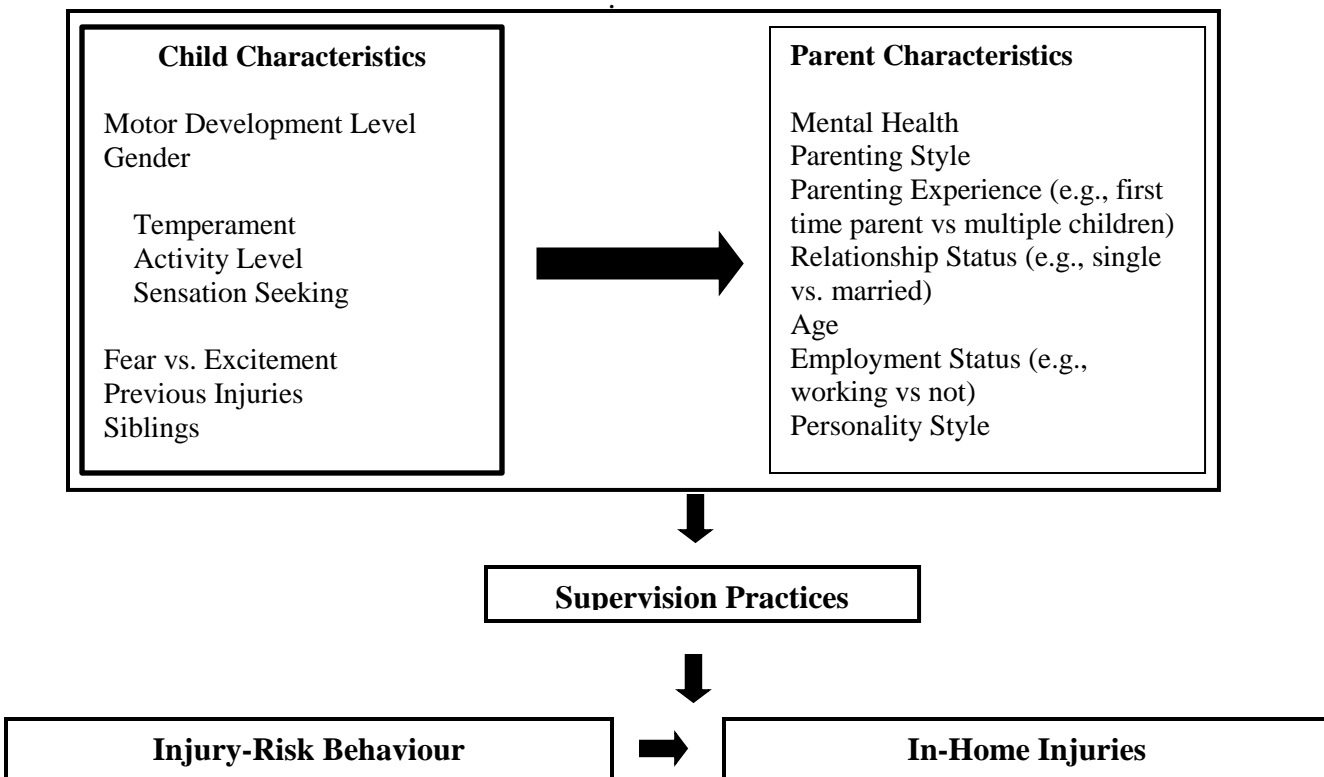


Figure 3. Child and parent behavioral attributes to be considered in future supervision research during infancy.

Appendix A – Ethics Approval

	RESEARCH ETHICS BOARD Certification of Ethical Acceptability of Research Involving Human Participants
---	--

APPROVAL PERIOD: October 25, 2012 to October 25, 2016

REB NUMBER: 12AU017

TYPE OF REVIEW: Delegated Type 1

RESPONSIBLE FACULTY: BARBARA MORRONGIELLO

DEPARTMENT: Psychology

SPONSOR: SSHRC STANDARD RESEARCH GRANT

TITLE OF PROJECT: Understanding changes in Caregiver supervision as children acquire motor skills during infancy

The members of the University of Guelph Research Ethics Board have examined the protocol which describes the participation of the human subjects in the above-named research project and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement.

The REB requires that you adhere to the protocol as last reviewed and approved by the REB. The REB must approve any modifications before they can be implemented. If you wish to modify your research project, please complete the Change Request Form. If there is a change in your source of funding, or a previously unfunded project receives funding, you must report this as a change to the protocol.

Adverse or unexpected events must be reported to the REB as soon as possible with an indication of how these events affect, in the view of the Responsible Faculty, the safety of the participants, and the continuation of the protocol.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and approvals of those facilities or institutions are obtained and filed with the REB prior to the initiation of any research protocols.

The Tri-council Policy Statement requires that ongoing research be monitored by, at a minimum, a final report and, if the approval period is longer than one year, annual reports. Continued approval is contingent on timely submission of reports.

Membership of the Research Ethics Board: B. Beresford, *Ext.*; F. Caldwell, *Physician*; C. Carstairs, *COA*; S. Chuang, *FRAN (alt)*; K. Cooley, *Alt. Health Care*; J. Clark, *PoliSci (alt)*; J. Devlin, *OAC*; J. Dwyer, *FRAN*; M. Dwyer, *Legal*; D. Dyck, *CBS*; D. Emslie, *Physician (alt)*; B. Ferguson, *CME (alt)*; H. Gilmour, *Legal (alt)*; J. Goertz, *CME*; B. Gottlieb, *Psychology*; B. Giguere, *Psychology (alt)*; S. Henson, *OAC (alt)*; G. Holloway, *CBS*; L. Kuczynski, *Chair*; S. McEwen, *OVC (alt)*; J. Minogue, *EHS*; A. Papadopoulos, *OVC*; B. Power, *Ext.*; V. Shalla, *SOAN (alt)*; J. Srbely, *CBS (alt)*; R. Stansfield, *SOAN*; K. Wendling, *Ethics*.

Appendix B – Motor Development Checklist (MDC)

Motor Development Checklist

Date of Call/Visit (mm/dd/yyyy)

		/	/	/	/	/	/	/	/
Rolling	Roll onto back from front								
	Roll onto front from back								
(Level 1)	Sitting	Pull to sit without head-lag							
		Sitting up with back support							
		Sitting up without back support							
		Sits without support and holds object							
(Level 2)	Standing	Pull self up to stand							
		Cruise along while holding on							
		Momentarily standing without holding on to any supports							
		Sustained standing without holding on to any supports							
(Level 2)	Sitting to Standing	Get to sitting form standing without good control							
		Sits down from standing with good control							
		Squats without support							
		Stoop and recover							
(Level 3)	Crawling	Crawl or move forward on stomach							
		Crawl or move backward on stomach							
		Crawling forward on hands/knees							
	*Also scooching	Crawling backward on hands/knees							
(Level 4)	Climbing	Climbing on things							
		If crawling up stairs							
		Goes down stairs on bottom or crawling backwards							
(Level 5)	Walking	Walking with support*****							
		Walking without support (at least 3 steps) = 5							
		Walking backwards = 5							
(Level 6)	Running	Running without support							
(Level 6)	Stairs	If standing as goes up stairs							
		Goes down stairs standing							

Appendix D – In View Diary Sheet

TIME USE INFO SHEET: IN VIEW**Doing something together**

1. What room is your child mostly in? (**Circle ONE only**)
KIT DR BATH BR LR/DEN PLAY STAIRS/HALL OTHER:____ UNKNOWN
2. If more than one person is supervising your child, who would you say is the **PRIMARY** supervisor? (**Circle ONE only**)
MOM DAD OTHER Caregiver (Who:_____)
3. What are they doing together? (Check off the one below that best describes their activity – **Check ONE only**)
 Some type of childcare (e.g., changing diaper, feeding, dressing, snack)
 Playing with or entertaining child in some way (e.g., reading, toys, singing, talking to child, etc).
 Other - Please indicate what this is: _____
 Don't Know
4. *If you were not taking the precautions you are in this situation*, what would the risk of injury be (i.e., your child getting hurt in some way) given where he/she is and what he/she is doing? (**Check ONE only**)
 No risk of injury
 Slight risk of injury
 Moderate risk of injury
 High risk of injury
 Very high risk of injury

OR**NOT doing something together (CHILD IS WITHIN VIEW OF THE SUPERVISOR BUT EACH IS DOING SOMETHING ON THEIR OWN)**

1. What room is your child mostly in? (**Circle ONE only**)
KIT DR BATH BR LR/DEN PLAY STAIRS/HALL OTHER:____ UNKNOWN
2. If more than one person is supervising your child, who would you say is the **PRIMARY** supervisor?
MOM DAD OTHER (Who:_____)
3. Which best describes how the supervisor is monitoring your child? (**Check ONE only**)
 Have him/her within *constant* view (not taking eyes off the child *at all*)
 Looking at him/her *intermittently* (e.g., look at child then look away and then look back at child, etc)
 Not looking at the child but listening closely (e.g., supervisor is reading but listening for child at all times)
 Not looking at the child and not listening closely (e.g., supervisor is focused on watching/listening to TV)
 Don't know
4. *If you were not taking the precautions you are in this situation*, what would the risk of injury be (i.e., your child getting hurt in some way) given where he/she is and what he/she is doing, or how s/he usually behaves there? (**Check ONE only**)
 No risk of injury Slight risk of injury Moderate risk of injury High risk of injury
 Very high risk of injury

TIME USE INFO SHEET: OUT OF VIEW

Participant #:

Date:

Time of day: (this time must correspond to the time on the Supervision Recording Sheet)

1. What room is your child mostly in? (Circle ONE only)

KIT DR BATH BR LR/DEN PLAY STAIRS/HALL OTHER:____ UNKNOWN

Is anyone with them? Yes _____ Who: _____

No _____

Don't know _____

2. If more than one person is supervising your child, who would you say is the PRIMARY supervisor? (Circle ONE only)

MOM

DAD

OTHER Caregiver (Who: _____)

3. What room is the supervisor mostly in? (Circle ONE only)

KIT DR BATH BR LR/DEN PLAY STAIRS/HALL OTHER:____ UNKNOWN

4. From where the supervisor is, can s/he/ HEAR what your child is doing?Yes X

No _____

Don't know _____

5. What is the supervisor doing at this time?

_____ Don't Know _____

6. What is your child doing at this time?

_____ Don't Know _____

7. Which best describes how the supervisor is monitoring your child? (Check ALL that apply)

_____ *Don't have to monitor* child because s/he knows how to behave there or can't gain access to anything that is unsafe (e.g., child is in the swing or playpen; hazards are all removed, etc)

Appendix E – Out of View Diary Sheet

_____ *Listening in* from where they are so supervisor knows what child is doing at all times

_____ *Going to check* on him/her every once in a while

When does the supervisor check?

_____ When he/she hear something that indicates child needs to be checked.

_____ Every 2-3 minutes

_____ Every 4-5 minutes

_____ Every 6-7 minutes

_____ Every 8-9 minutes

_____ Every 10 minutes, or longer

_____ *Watching* child pretty much the whole time

_____ *Don't know*

Appendix F – Injury Diary Form

'MY CHILD GOT HURT' - DIARY FORM

Date (dd/mm/yy): _____

Time: _____ AM / PM

Briefly describe what happened to result in your child getting hurt: _____

1. What part of his/her body got hurt? _____

2. What was the type of injury? (e.g., bump, bruise, puncture, scrape, cut, crushing injury, burn, etc):

3. Where was your child exactly? _____

4. What was your child doing at the time? _____

5. How serious do you think the injury...

...actually was?

...might have been?

- 1 = Not at all serious
- 2 = A tiny bit serious
- 3 = Somewhat serious
- 4 = Pretty serious
- 5 = Very serious

- 1 = Not at all serious
- 2 = A tiny bit serious
- 3 = Somewhat serious
- 4 = Pretty serious
- 5 = Very serious

6. Where were you at the time your child got hurt? _____

7. What were you doing at this time? _____

8. Who actually was 'in charge' of the child at the time of the injury?

- _____ Me
- _____ My partner/spouse
- _____ Older sibling: [age _____ years]
- _____ No one in particular
- _____ Other: Who? _____

9. Who do you think is most responsible for your child getting hurt (*Check only one*)?

_____ No one really (bad luck) _____ Child _____ Me _____ Other person

10. Had the child ever before done what led to him/her getting hurt:

- _____ Not with me but probably has done it before
- _____ No (not as far as I know)

_____ Yes: Ever hurt before? _____ Yes _____ No

Appendix F (Continued)

11. Which of the following best describes the level of supervision of the child by the person in charge at the time the child was hurt? Please answer both part A and B.

a) Pick ONE of the following and then answer the question that follows, if there is one:

_____ Person in charge was beyond reach of the child
[Was the person within yelling distance of child? Yes_____ No_____]

_____ Person in charge was within reach of the child
[Was the person touching/holding the child? Yes_____ No_____]

_____ I don't know the person's proximity to the child

b) Pick ONE of the following:

_____ Person in charge was constantly watching the child

_____ Person in charge was not constantly watching but was constantly listening in on the child

_____ Person in charge was intermittently listening in or watching the child
[About how frequently was the person checking on the child: every _____ minutes]

_____ I don't know how attentive the person was to the child at that time

12. Sometimes, supervision can make a difference for whether or not a child gets hurt and other times it really doesn't make much difference because children get hurt doing things that are typical of how children behave. So there isn't much one can do about it even if you are right there supervising them.

Think about how your child got hurt, and then select ONE answer to tell me whether you

agree **OR** disagree with the following statement, and how much:

"Probably, closer supervision would have prevented him/her from getting hurt."

(Select one answer from the following 6 choices)

I disagree with the statement:

1 = Completely
2 = Moderately
3 = A little

OR

I agree with the statement:

4 = Completely
5 = Moderately
6 = A little

13. How typical do you think it is for children at this age to get hurt in this way?

1 = Not typical at all 4 = Very typical
2 = A bit typical 5 = Completely typical
3 = Pretty typical

14. Knowing your child, how likely do you think it is that he/she might get hurt again in this way while at home?

1 = Not at all likely 4 = Fairly likely

2 = A bit likely
3 = Somewhat likely

5 = Very likely

Appendix F (Continued)

15. At this time, have you done anything special, or do you plan to do anything special, to decrease the likelihood that your child would get hurt again this way in the future?

_____ YES _____ NO

If yes: What? _____

Did you do it already or is this something you plan to do? _____ Done _____ Plan to do

Appendix G - Risk Behaviour Diary Form

Infant Injury-Risk Behaviour Diary Sheet

Participant #: _____

Today's Date (DD/MM/YY): _____ Time when this happened: _____

1. Who was supervising at the time: ___ Mom ___ Dad ___ OTHER [Who: _____]

2. Describe *exactly* what the child did that was dangerous: _____

3. Where did the child do this (room, location in room): _____

4. Were you able to catch the child in the act or did you become aware of this after s/he did it?

___ became aware of his/her behaviour afterwards

___ caught him/her in the act

How did you become aware of what the child was doing or had done?

___ Heard something ___ Saw something ___ Someone alerted me ___ Child said it

___ Parent intuition made me check on child

___ Other [WHAT: _____]

5. About how many times has the child done this before today? Enter a number: _____

6. Has s/he ever gotten hurt before doing this? ___ No ___ Yes

7. What room was supervisor in + doing what? _____

8. At the time the child did this, s/he was:

___ *in view* of supervisor OR ___ *out of view* of supervisor [CHECK ONLY ONE]___ *within reach* of supervisor OR ___ *beyond reach* of supervisor [CHECK ONLY ONE]

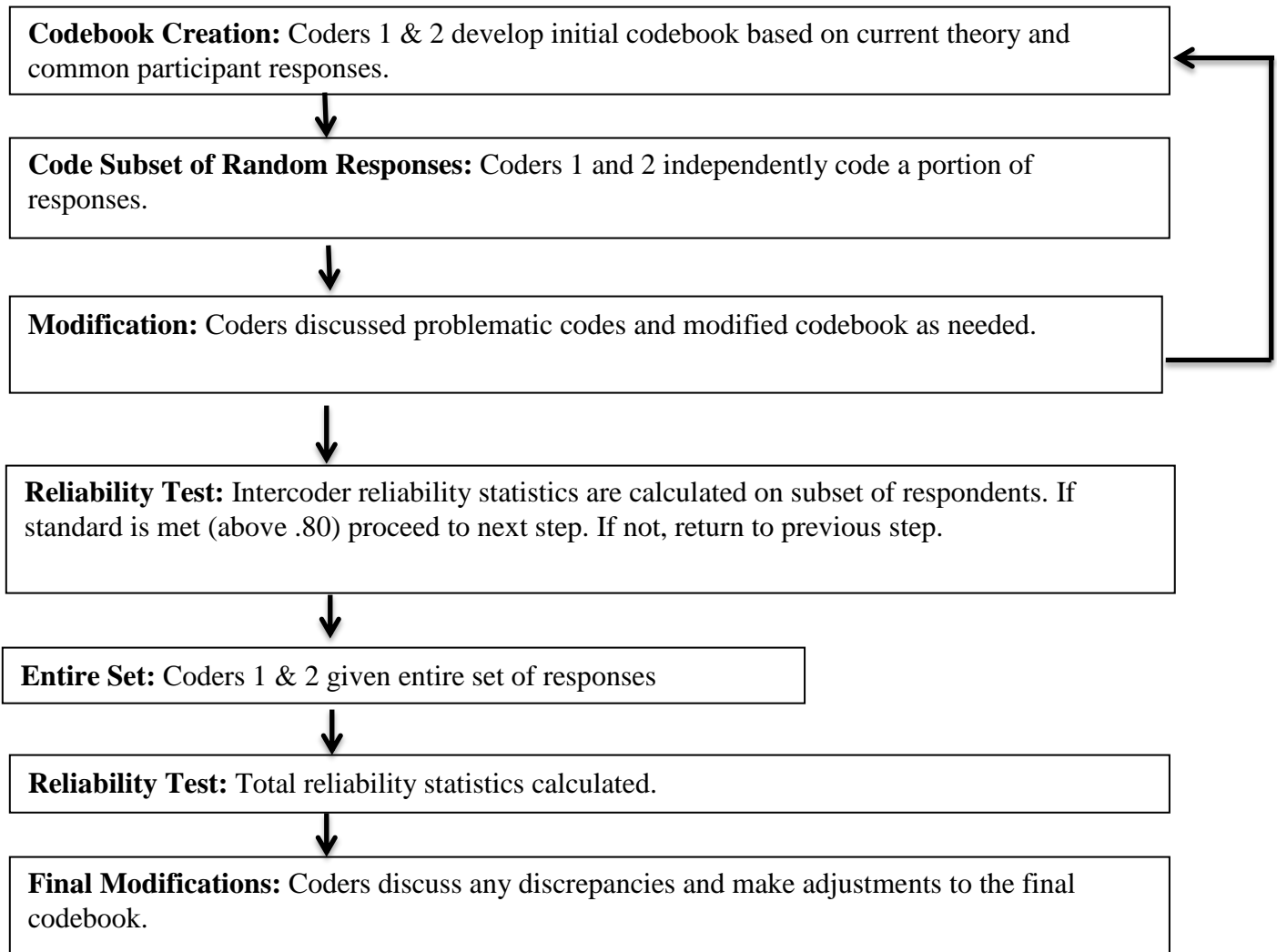
How many minutes had it been since the supervisor had last laid eyes on the child? _____ mins

Use this scale to answer these few questions (circle the appropriate number)

1 = not at all 2 = a little 3 = somewhat 4 = a fair amount 5 = very

- | | | | | | |
|--|---|---|---|---|---|
| 1. How surprised were you by what your child did today? | 1 | 2 | 3 | 4 | 5 |
| 2. How likely is it that your child will try this again? | 1 | 2 | 3 | 4 | 5 |
| 3. How much can parents prevent these types of behaviours? | 1 | 2 | 3 | 4 | 5 |
| 4. How typical are these types of behaviours at this age? | 1 | 2 | 3 | 4 | 5 |
| 5. How much do you 'worry' about your child getting hurt from doing these types of things? | 1 | 2 | 3 | 4 | 5 |
| 6. How intensely did you react to your child doing this today? | 1 | 2 | 3 | 4 | 5 |
| 7. How much does your child understand about the danger of doing this? | 1 | 2 | 3 | 4 | 5 |
| 8. How well do you think your child understood that you do not want him/her to do this? | 1 | 2 | 3 | 4 | 5 |
| 9. How much do you agree that closer supervision would have prevented him/her from doing this? | 1 | 2 | 3 | 4 | 5 |
| 10. How compliant do you think your child will be about not doing this in the future? | 1 | 2 | 3 | 4 | 5 |

Appendix H – Process for Creating Coding Manual



Note: This figure was adapted from Hruscka et al. (2004) and modified to fit how the coding manual was created for the context of this study.