Understanding Children's Injury-risk Behaviors: The Independent Contributions of Cognitions *and* Emotions

Barbara A. Morrongiello[1] and Shawn Matheis
[1]*Psychology Department, University of Guelph*

Objective Unintentional injuries are a leading threat to the health of elementary-school children, with many injuries happening when children are left to make their own decisions about risk taking during play. The present study sought to identify determinants of children's physical taking. **Methods** An ecologically valid task that posed some threat of injury was used (i.e., highest height of a balance beam they would walk across). Ratings of cognitions (extent of danger, perceived vulnerability for personal injury, potential severity of injury) and emotional reactions (fear, excitement) were taken when on the beam, just before the children walked across. **Results** Regression analysis, controlling for age and sex, revealed that risk taking was predicted from ratings of danger, fear, and excitement. **Conclusions** Both cognitive and emotional factors independently contribute to predict children's physical risk taking. Theoretical and practical implications of these findings are discussed.

Key words children; cognitions; determinants; emotions; risk taking.

Unintentional injury poses a significant threat to children's health. Identifying those factors that lead children to engage in *physical risk taking* (i.e., a behavior that could result in physical injury when there are alternative behaviors that do not do so) is essential to support the development of evidenced-based injury-prevention programs. The aim of the present study was to assess if both cognitive and emotional factors predict children's physical risk taking using an ecologically valid measure of risk taking. There is considerable evidence that cognitions (e.g., appraisal of danger, perceptions of injury vulnerability) influence injury-risk behaviors among adults (e.g., Glik, Kronenfeld, & Jackson, 1991; Peterson, Farmer, & Kashani, 1990; Russell & Champion, 1996), adolescents (e.g., Jelalian et al., 1997; Moore & Gullone, 1996), and even school-age children (Hillier & Morrongiello, 1998; Morrongiello & Rennie, 1998). Although emotions (e.g., feelings of excitement vs. fear) also have been shown to relate to health-risk behaviors among adolescents and adults, few studies have considered the contribution of emotions to decisions children make about physical risk taking. Moreover, notably lacking are studies in which: (a) an ecologically valid task has been used to study children's physical risk taking; (b) cognitions and emotions *both* have been examined to determine if each uniquely predicts children's physical risk taking; and (c) interactions of age and gender with cognitions or emotions have been examined and related to children's physical risk taking. The present study addressed these important issues.

Unintentional Childhood Injury

In Canada and the United States, as in most other industrialized nations, unintentional injury is the leading cause of death for children over one year of age (Canadian Institute of Child Health, 2000; National Center on Injury Prevention and Control, 2005). In fact, more children die from injuries than from all diseases combined (Rodriguez, 1990). Injury is also a leading cause of hospitalization during childhood. Estimates indicate that approximately 25% of children in the United States require treatment for injuries annually (Scheidt et al., 1995). Thus, unintentional injury is a pervasive and substantial child health problem.

Children's risk of injury, however, varies with age and gender. Although it is difficult to compare injury rates across age due to the confounding of risk exposure with developmental level (e.g., younger children are less

All correspondence concerning this article should be addressed to Barbara A. Morrongiello, Psychology Department, University of Guelph, Guelph, Ontario N1G 2W1 Canada. E-mail: bmorrong@uoguelph.ca.

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likely to bike near traffic than older children), evidence suggests that injury rates increase with age throughout the school years and peak in adolescence (Schiedt et al., 1995). Similarly, there is evidence to suggest that physical risk taking increases with development (Hillier & Morrongiello, 1998), although few studies have directly addressed this question.

At virtually every age, and for all types of injuries, boys experience more frequent and severe injuries than girls (Baker, O'Neil, Ginsburg, & Li, 1992; Canadian Institute of Child Health, 2000). Consistent with these gender differences in injury rates, results from laboratory and field-based observational studies reveal that boys engage in greater physical risk taking than girls (Ginsburg & Miller, 1982; Morrongiello & Dawber, 1998; Morrongiello & Rennie, 1998; Rosen & Peterson, 1990). Thus, age and gender differentially influence children's physical risk taking and their likelihood of injury. In the present study we examined whether age and gender interacted with other factors of interest to predict children's decisions in a risk-taking task.

Although children's risk of different types of injury varies with developmental level (e.g., toddlers are more likely to ingest poisons than school-age children), some types of injuries are common across age. Fall-related injuries, for example, pose a significant health threat throughout childhood. Estimates indicate that falls account for one-third of all injury-related emergency visits by children. Falls on playgrounds pose a particular threat for children from preschool throughout the elementary-school years (Phelan, Khoury, Kalkwarf, & Lamphear, 2001). A critical risk factor for serious injury from falls is the height at which children are when they fall (Laforest, Robitaille, Lesage, & Dorval, 2001; Macarthur, Hu, Wesson, & Parkin, 2000). Drawing on these statistics, in the present study we developed a risk-taking task in which children selected the height of the equipment, with falling being a potential threat to their physical well-being.

Because of the scope of the childhood injury problem, there have been numerous calls for research to identify factors that elevate children's risk of injury so that prevention programs can be developed to address these issues (Finney et al., 1993; Roberts, 1995). For infants and pre-school children many injuries occur in and around the home (Shannon, Brashaw, Lewis, & Feldman, 1992), therefore, researchers target caregivers' beliefs and/or behaviors in their efforts to reduce children's risk of injury (e.g., Lewis, DiLillo, & Peterson, 2004; Morrongiello & Kiriakou, 2004). For school-age children, however, injuries often occur when they are left to make independent decisions about risk taking (Morrongiello, 1997; Shannon et al., 1992; Scheidt et al., 1995). Hence, studies of injury risk at these ages often focus on individual child characteristics, particularly temperament and behavioral attributes, such as impulsivity, activity level, or inhibitory control (DiScala, Lescohier, Barthel, & Li, 1998; Plumert & Schwebel, 1997; Schwebel & Bounds, 2003; Schwebel & Plumert, 1999; Wazana, 1997).

Recently, researchers also have begun to examine the influence of children's cognitions (Morrongiello, 1997; Morrongiello & Rennie, 1998) and emotional responses (Morrongiello & Sedore, 2005) in situations posing risk of physical injury. To date, however, studies have focused either on cognitions *or* emotional factors, rather than examining the relative importance of both factors for predicting children's risk taking. The development of effective injury-prevention programs, however, necessitates that we determine the relative importance of these two domains of influence, and also whether the impact of these predictors of risk taking varies with child age and/or gender. Moreover, the methods used in the research to date have been quite limited. Tasks of convenience (e.g., hypothetical stories, line drawings) that pose no threat of injury lack ecological validity, making it more difficult to fully assess the contributions of both cognitions and emotions in predicting children's risk taking. For example, to the extent that hypothetical situations or line drawings are limited in their capacity to elicit much emotional responding, using such tasks is highly likely to underestimate the impact of emotions on risk taking. To address these limitations, in the present study both cognitions *and* emotions were measured and these were related to children's decisions in an actual injury-risk situation.

Cognitive Determinants of Risk taking

A number of theories have been developed to explain how cognitive factors (i.e., attitudes, beliefs) influence the decisions individuals make about health behaviors (e.g., Health Belief Model, Janz & Becker, 1984; Theory of Planned Behavior, Ajzen, 1991). A substantial body of research has shown that cognitive factors relate to risk taking for adults (Glik et al., 1991; Peterson et al., 1990; Russell & Champion, 1996) and adolescents (Jelalian et al., 1997; Moore & Gullone, 1996). Drawing on these findings, Morrongiello and her colleagues assessed if children's physical risk taking could be predicted based on their cognitions (Morrongiello & Rennie, 1998). In a study of almost 300 children, three cognitive characteristics

of individuals differentiated risk takers and avoiders with over 80% accuracy: Appraisal of danger, beliefs about personal vulnerability for injury, and attributions for injury (self, other, bad luck). Individuals who rated the danger as high, perceived themselves as personally vulnerable for injury in the situation, and anticipated that injuries would be attributable to themselves, were more likely to avoid risk taking. In contrast, those who rated danger and perceived vulnerability as low and who anticipated that injury would not be attributable to their own behavior endorsed greater risk taking. Similarly, Hillier & Morrongiello (1998) found that ratings of potential injury severity also affected children's risk decisions. Specifically, those who anticipated a serious injury avoided risk taking, whereas those who did not consider the possibility of a serious injury engaged in greater risk taking (see also Peterson, Brazeal, Oliver, & Bull, 1997). Thus, consistent with the findings from adults and adolescents, a number of cognitive factors have been shown to significantly influence children's decisions about engaging in behaviors that threaten their safety.

Emotional Determinants of Risk taking

Research with adults and adolescents reveals that anticipated emotional reactions also play an important role in directing risk decisions. In fact, emotional reactions have been found to be so critical in adult decisions about risk that Zuckerman (1994) has argued that individuals' emotional motivations (e.g., avoidance of fear, seeking out excitement and fun) are key predictors of risk taking. Similarly, emotional responses of adolescents have been shown to contribute to decisions they make about a variety of health risk behaviors, including drug use, smoking, and drinking (Barnea, Teichman, & Rahar, 1992; Clayton, Cattarello, & Walden, 1991; Zuckerman, 1979). Thus, a variety of sources of evidence suggest that emotional reactions influence risk taking, at least for adolescents and adults.

Whether emotions influence children's actual behavior in an injury-risk situation remains to be determined. Individual differences have been reported for children's emotional reactions to simulated injury-risk play situations, with some children reacting predominantly with excitement and others with fear (Morrongiello & Sedore, 2005; Peterson, Gillies, Cook, Schick, & Little, 1994). Children also have been shown to attend to the emotions communicated on the faces of peers in injury-risk situations (fear vs. excitement) and to interpret these as relevant to risk of injury. Specifically, when children observe a risk-taking peer who looks fearful then they rate risk of injury for the activity as greater compared to when the peer looks excited (Morrongiello & Rennie, 1998). Children's emotional reactions also have been related to their intentions to approach or avoid different hypothetical situations (Morrongiello & Matheis, 2004). However, whether emotional reactions predict risk-taking behavior in childhood remains to be determined. In sum, these few studies support the premise that emotional reactions *may* contribute to explain how children respond (risk taking vs. risk avoidance) in injury-risk situations. The present research directly addressed this question.

Selection of an Appropriate Task for the Present Research

Historically, research on decision-making in childhood has utilized laboratory-based procedures that have the benefit of allowing precise control over the conditions presented and careful measurement of children's behavior. The most commonly used task is some type of gambling task that is modeled after the Iowa Gambling Task used in adult research on decision-making (Bechara, Damasio, Damasio, & Anderson, 1994). Although gambling tasks can be effective for assessing children's decision-making under different conditions of costs and benefits (e.g., Kerr & Zelazo, 2004; Miller & Byrne, 1997), these tasks provide limited insight into children's decision-making in situations that pose some threat of physical injury. For one thing, in a gambling task one usually is allowed many trials over which one can assess how best to respond to maximize benefits and minimize losses. In an injury-risk situation, however, physical risk taking can result in an immediate and quite substantial loss (i.e., injury), leaving little opportunity to learn from experience without suffering a loss. Recent evidence indicates also that performance on the gambling task does *not* relate to health-risk behaviors (e.g., substance use) in adolescents and adults (Overman et al., 2004). Thus, although a gambling task may be appropriate for studying some aspects of children's decision-making, it is not appropriate if one aims to study decision-making relevant to injury-risk situations.

Because of our interest in studying emotional contributions to physical risk taking, the use of an ecologically valid task that actually placed the child at risk for physical injury seemed essential in order to elicit emotional responses. An additional requirement was that all children needed to have comparably low experience with the task because experience is a confound variable that has been shown to influence children's decisions

in injury-risk situations (Morrongiello & Dawber, 2004). Finally, the task had to be acceptable to parents, teachers, and ethics review boards. After considerable pilot testing and surveying of children, we found one task that met these multiple requirements, namely, a balance beam activity in which the child was asked to select the highest height at which he/she would cross a balance beam and then to do so. To confirm that children responded on this task in ways consistent with how they typically behave, children completed a standardized questionnaire measure of typical level of engagement in injury-risk behaviors, with the expectation that scores on the present task and this questionnaire measure would be positively correlated to some degree.

The Present Study

As outlined earlier, studies of physical risk taking in children have been limited in several ways. First, hypothetical risk situations lack ecological validity and provide a poor test of how emotional reactions contribute to risk-taking decisions. They also can yield distortions in the data due to social desirability or self-presentation biases, thereby providing a poor indication of how children actually would behave when experiencing an injury-risk situation first hand. Second, focusing purely on emotions without also considering cognitions, or vice versa, provides only a limited view of the determinants of risk taking and limits our understanding of the relative importance of these factors in predicting children's behavior in injury-risk situations. Finally, most prior studies fail to assess how cognitive and emotional determinants of physical risk taking vary with age and/or gender of the child. Given that risk taking increases with age and is greater for boys than girls, these are important child attributes to consider in identifying determinants of injury-risk behavior. The present study was designed to address these important issues.

Boys and girls in three age groups (spanning 7 through 12 years of age) completed the injury-risk task of setting the height of the balance beam and walking across it. During the task, the children provided ratings both of cognitions (danger, vulnerability for falling, potential severity of injury) and emotional reactions (fear, excitement).

Method

Participants

Participants included 242 children (129 boys and 113 girls), who were recruited from grades 2 through 7 and then assigned to one of three age groups: *Young* or 7- and 8-year-olds ($N = 84$, $M = 7.54$ years, $SD = .50$), *middle* or 9- and 10-year-olds ($N = 90$, $M = 9.41$ years, $SD = .50$), and *older* or 11 and 12 years of age ($N = 68$, $M = 11.46$ years, $SD = .50$). Children were recruited from four schools that were selected in a purposeful way to obtain a broad sampling of socio-economic groups; type and cost of local housing were used as proxy indicators of economic status. The rate of success in recruiting participants was approximately 62% across these four schools. Approval for the research was obtained from the Institutional Review Committees at the University of Guelph and the Upper Grand District School Board. As well, parents gave written consent and children gave verbal assent prior to participation. All children were fluent in English, in regular classrooms, and had never been hospitalized for an injury or participated in recreational gymnastics (i.e., no one had prior experience performing this type of task). The sample comprised predominantly Caucasian families.

Measures

Risk-taking Task

Each child participated in the balance beam task in which he/she selected the height of the beam and then walked across it independently; no other children were present when the child did this task. The balance beam apparatus was custom designed. The beam itself, 4 feet in length and 8 inches in width, attached to a set of steps located on each end of the beam. There were eight incremental wooden steps, each eight inches in height, resulting in steps spanning 8–54 inches from the floor. The beam was easily movable and could be set at any of the eight step heights (e.g., step 1 was 8 inches from the floor, etc.). To perform the task children walked up and down, looking down from each step, and decided on the height at which they would cross the beam. The beam was then positioned at that step height and the child then was asked to walk across it; all children completed this crossing successfully. Their *risk-taking score* corresponded to the step height at which they set the beam (1–8), with higher numbers indicating greater risk taking. Ratings of danger (*How dangerous do you think it is to walk the balance beam at this height?*), vulnerability (*How likely do you think it is that you could lose your balance and fall off the beam and get hurt?*), potential injury severity (*How hurt do you think you could get if you were to fall off the beam at this height?*), excitement (*How excited do you feel now that you're getting ready to walk the beam?*), and fear (*How scared do you feel now that you're getting ready to walk the beam?*) were completed while the child stood on the beam just before walking across it, with possible

scores ranging between 0 and 4 and higher scores indicating greater endorsement of the attribute; order of ratings across children was randomized.

Questionnaires

Each child completed the Injury Behaviour Checklist (IBC, Speltz, Gonzales, Sulzbacher, & Quan, 1990), which is a standardized measure of injury-risk behavior (e.g., jumping down steps, playing with things that could cause a fire, teasing or approaching animals they do not know) that has been found to correlate with actual injuries in children (Morrongiello, Ondejko, & Littlejohn, 2004; Potts, Martinez, & Dedmon, 1995). For each of 24 items the individual reports on the frequency (5-point Likert scale) with which they engage in the behavior listed, with higher numbers indicating greater engagement in injury-risk behaviors.

Although the IBC was originally developed for completion by parents, we elected to have children complete it themselves, and we did so for several reasons (cf., Morrongiello & Rennie, 1998). At these older ages, children are often better informants than parents about injuries and risk taking, with parents not often told about minor injuries or risk-taking behaviors (Morrongiello, 1997; Peterson, Harbeck, & Moreno, 1993). Second, children routinely engage in greater risk taking than their parents would have them do (Morrongiello & Bradley, 1997; Morrongiello & Dawber, 2004). Both of these factors would likely result in parent reports being biased towards under-reporting about children's actual risk taking. For these reasons, therefore, having children report on their own risk behaviors was deemed best. Internal consistency was .88 and none of the children had any difficulty understanding or rating the individual items; these were essentially the same items as those on the original IBC, except that examples were sometimes provided in order to help the child understand the item fully (e.g., *Play with sharp objects, such as knives or sharp tools*).

Procedure

Testing took place in a quiet room at school. After completing the consent form, the child was instructed to select the height at which he/she would walk across the balance beam. Each child was asked to go up and down the stairs, one at a time, until he/she decided on the step representing the maximum height at which he/she would want the beam set. The beam was then set at that height, cognitive and emotional ratings were taken, and the child then walked across the beam.

During their walk across the beam, the safety of the participants was ensured by the presence of a gymnastics coach (i.e., trained in breaking falls from the balance beam so as to prevent injury) and gym mats that appeared to be flooring; the coach appeared distracted with paperwork off to the side and the child did not know this person was serving as a spotter. In each age group, half the boys and girls were assigned to complete the IBC after the task and the remainder completed it before the task in order to avoid order effects influencing the results. At the conclusion of the session, participants were thanked for their cooperation and offered small gifts for their participation.

Results

Task Validity

To assess the validity of the balance beam task, preliminary analyses were conducted comparing performance with typical levels of risk taking as reported on the Injury Behavior Checklist. Risk taking on the balance beam task positively correlated with reports of typical levels of injury-risk behavior on the IBC after controlling for age and sex, $r(238) = .21$, $p < .001$. Thus, children responded in this laboratory task in ways generally consistent with how they typically respond in day-to-day situations, although the magnitude of this correspondence was far from perfect.

Demographic Variations in the Measures

Table I shows scores for each measure as a function of group and sex. An Analysis of Variance was applied to each measure separately with age (3) and sex (2) as between-subject factors. Results revealed significant sex [$F(1, 236) = 10.00$, $p < .01$] and age [$F(2, 236) = 10.03$, $p < .01$] differences in risk taking. Consistent with prior research, boys engaged in greater risk taking than girls (see Table I). Follow-up tests, using Fisher's Least Significant Difference procedure with a Bonferroni correction, confirmed that children in the young and middle age groups engaged in comparable levels of risk taking, but these levels fell significantly below the risk taking of older children ($p < .01$). For the cognitive measures (danger, vulnerability, severity), there were no significant age or sex differences in any of the ratings. For the emotional measures, however, for both the scared and excited ratings, significant sex [$F(1, 236) = 14.54$ and 31.67, respectively, $p < .01$] and age [$F(2, 236) = 16.24$ and 5.24, respectively, $p < .01$] differences were obtained. Boys were more excited than girls and girls were more scared than boys (Table I). Follow-up tests, using Fisher's

Table I. Average ratings as a function of age group and sex

	Age group			Sex	
Measure	Young	Middle	Older	Boys	Girls
Risk Taking[a]	5.44 (1.95)	5.47 (1.90)	6.62 (1.40)	6.96 (1.82)	5.58 (1.89)
Cognitions					
Danger	1.18 (1.21)	1.16 (0.96)	1.29 (0.83)	1.22 (1.03)	1.19 (1.01)
Vulnerability	1.17 (1.13)	1.17 (0.81)	1.15 (0.74)	1.16 (0.88)	1.16 (0.95)
Severity	1.31 (1.16)	1.29 (1.06)	1.22 (0.73)	1.25 (1.02)	1.31 (1.01)
Emotions					
Scared[a]	2.48 (0.82)	2.32 (0.69)	1.87 (0.58)	2.05 (0.72)	2.40 (0.74)
Excitement[a]	2.73 (0.89)	2.80 (0.81)	3.10 (0.78)	3.12 (0.85)	2.56 (0.73)

Note: The range for risk taking is 1–8; the range for all other measures is 0–4. Standard deviations are indicated in parentheses.
[a]Main effects of Age and Sex were obtained.

Table II. Inter-correlations between risk taking, and ratings of danger, vulnerability, severity, fear, and excitement

	1	2	3	4	5	6
1. Danger	–	.40**	.47**	0.28**	−.08	−.52**
2. Vulnerability	–	–	0.46*	0.32**	−.09	−.24**
3. Severity	–	–	–	0.40**	−.07	−.34**
4. Fear	–	–	–	–	−.26**	−.32**
5. Excitement	–	–	–	–	–	0.33**
6. Risk Taking	–	–	–	–	–	–

*$p < 0.05$.
**$p < 0.01$.

Least Significant Difference procedure with a Bonferroni correction, revealed that children in the young and middle age groups gave comparable ratings of excitement, but these scores fell significantly below those for the older children ($p < .01$). Children's ratings of fear systematically declined with increasing age ($p < .01$). Thus, in this task, boys and older age children showed greater risk taking and experienced less fear and more excitement, in comparison to girls and younger children.

Determinants of Children's Risk taking

To identify those factors that predicted risk taking, a hierarchical regression was conducted. Preliminary screening to test for meeting statistical assumptions (cf., Tabachnick & Fidell, 1989) was conducted to check for outliers, distribution issues, and multicollinearity, resulting in one outlier being eliminated from the analyses. Age was coded as a continuous variable and sex as categorical (0 = boys, 1 = girls), and these factors were entered in Step 1 to control for their effects on risk taking. The cognitive measures included ratings of danger, vulnerability, and injury severity. The emotion measures included ratings of excitement and fear. The inter-correlations among these factors appear in Table II. The cognitive and emotion variables were entered simultaneously, along with all interaction terms arising from crossing the two demographic factors with each cognitive and emotion measure. Regression results are shown in Table III and confirm the importance of both cognitive *and* emotion-based factors in predicting children's risk taking.

Table III. Summary of regression analysis predicting risk taking ($N = 241$) from child factors

Step	Predictor	*B*	*SE*	R^2
1	Demographics			0.05
	Sex*	−0.38	0.23	
	Age*	0.25	0.07	
2	Cognitions & Emotions			0.34
	Danger*	−0.81	0.11	
	Vulnerability	−0.06	0.13	
	Severity	−0.16	0.12	
	Fear*	−0.35	0.12	
	Excitement*	0.25	0.08	
				0.39

*$p < 0.05$.
Note: Age was coded continuously by year; Sex: 0 = male, 1 = female; age was crossed with each cognition and emotion factor but yielded nonsignificant effects; in the interest of saving space, these five interaction terms are not listed. Sex was crossed with each cognition and emotion factor but yielded non-significant effects; in the interest of saving space, these 5 interaction terms are not listed.

As shown in Table III, predictors of risk taking included Age, Sex, ratings of Danger, Fear, and Excitement, with the full model accounting for 39% of the variance in children's risk decisions. Step 1 was significant, $F(2, 238) = 7.67$, $p < .01$, accounting for 5% of the variance. With increasing age, children engaged in more risk taking ($t = 3.54$, $p < .01$) and males showed more risk taking than females ($t = -3.28$, $p < .01$). A significant Step 2 [$F(5, 233) = 21.95$, $p < .01$] revealed that cognitions and emotions both predicted risk taking, accounting for 34% of the variance. Higher ratings of danger predicted less risk taking, $t = -7.18$, $p < .01$. Experiencing fear also was associated with less risk taking, $t = -2.80$, $p < .01$. In contrast, experiencing

excitement predicted increased risk taking, $t = 2.20$, $p < .05$. Thus, risk taking was predicted not only from age and sex, but also from both cognitive and emotion-based factors.

Discussion

Using an ecologically valid task that actually placed children in an injury-risk situation, the present findings revealed that risk taking varied with demographic characteristics (age, sex) and was predicted both by cognitive and emotional responses. Each of these issues is considered subsequently.

Risk-taking Tasks

Most research to date on children's risk-taking decisions has utilized tasks of convenience that necessitate that the child imagine himself in different situations or has had children complete gambling tasks that entail the manipulation of real losses and gains, but bear little relation to real-life situations that pose risk of physical injury. Children may not be capable, however, of reliably reporting how they might feel in real life based on being shown a drawing about a risk situation. Similarly, recent research with adolescents and adults indicates that decision-making on gambling tasks bears no relation to decision-making about health-risk behaviors (Overman *et al*., 2004). Thus, task selection is an important aspect of studying risk taking, particularly if one is interested in decisions about physical risk taking. One implication of this is that conceptual models that are developed to explain *physical* risk taking (Morrongiello & Lasenby, 2007) may be quite different from those that seek to explain decisions about risk in non-injury contexts (e.g., Miller & Byrnes, 1997). Theories about risk taking, therefore, must be developed based on results from research using tasks appropriate to the decision-making context one wishes to explain.

In the present study, because of our interest in the study of emotions, we felt it was essential to devise an ecologically valid task that actually posed some threat of physical injury, thereby increasing the likelihood of arousing emotional responses and providing an opportunity for us to evaluate the impact on risk taking of both emotional and cognitive factors. The balance beam proved quite useful for this purpose. Comparing performance on this task with that reported on the IBC revealed a significant positive correlation indicating that children who engaged in greater risk taking on this task also reported typically engaging in frequent injury-risk behaviors in other situations. This provides some evidence for task validity (see also Morrongiello & Sedore, 2005).

Demographic Characteristics and Risk taking

Consistent with prior research (Morrongiello & Rennie, 1998), with increasing age children generally engaged in more risk taking, a behavioral trend that the developmental literature indicates is likely to continue throughout adolescence (Arnett, 1992; Furby & Bythe-Marom, 1992; Schiedt et al., 1995). With increasing age, there also was a decline in children reporting fear and an increase in children reporting excitement in the current risk situation. Interestingly, recent research on neurobehavioral systems has found that during adolescence there is increased reporting of excitement, as well as increased risk taking. Moreover, this heightened responsiveness functions to stimulate certain underactive circuits in the brain that play a role in the control of emotions and behavior (Bjork et al., 2004). Possibly, these same circuits also explain the age-related increases in excitement and risk taking among pre-adolescents in the present study.

The fact that boys engaged in greater risk taking than girls on the balance beam task replicates one of the most robust findings in the injury literature (Baker et al., 1992; Canadian Institute of Child Health, 2000), adding further indirect support for the validity of the balance beam task. Boys' greater risk taking has been shown to result not only in more frequent injuries, but also in more severe injuries, compared to girls (Rivara, Bergman, LoGerfo, & Weiss, 1982). Studies on the determinants of children's risk decisions, therefore, are particularly important in order to determine if the factors leading to risk taking are comparable for boys and girls. In the present study, sex did not interact with cognitive or emotional factors to differentially predict risk taking for boys and girls. Thus, the determinants of risk taking were similar for boys and girls.

Cognitive and Emotional Determinants of Risk Taking

Consistent with prior research (Hillier & Morrongiello, 1998); Morrongiello, 1997; Peterson et al., 1994), children's appraisals of danger predicted risk taking. Interestingly, attempts to relate children's perceptions of injury severity and vulnerability for injury to risk taking have yielded mixed results. In the present research, for example, these factors did not systematically relate to risk taking, whereas some prior studies have found these

factors to predict children's risk decisions (Hillier & Morrongiello, 1998; Morrongiello & Rennie, 1998). It may be that perception of danger is the most robust cognitive determinant of risk taking, thus, it emerges regardless of the specific task used to assess risk taking. In contrast, whether vulnerability and severity ratings predict children's risk taking may vary depending on task requirements. Suffice it to say, the fact that some aspects of cognitions predict risk taking in children, as has been shown for adolescents (Jelalian et al., 1997; Moore & Gullone, 1996) and adults (Glik et al., 1991; Peterson et al., 1990; Russell & Champion, 1996), confirms that cognitions play a substantive role in predicting health-risk behaviors across a broad age range, just as one would expect based on popular theories of health-risk behaviors (Health Belief Model, Janz & Becker, 1984; Theory of Planned Behavior, Ajzen, 1991).

Prior research with adolescents and adults indicates that emotional responses also contribute to risk decisions (Barnea et al., 1992; Bechara, 2004; Clayton et al., 1991; Zuckerman, 1979, 1994). Emotional factors have been shown to affect children's perceptions of risk (Morrongiello & Rennie, 1998; Morrongiello & Sedore, 2005; Peterson et al., 1994). The present findings extend these conclusions, however, by indicating that emotional factors directly influence actual risk-taking behavior in school-age children: Those who experienced fear engaged in less risk taking, whereas those who felt excitement showed greater risk taking. Thus, across a broad age range there is evidence that risk decisions derive not only from what individuals think in risky situations, but also from the emotions they feel in these situations. Moreover, the findings from the present study highlight the important and *independent* contribution that both cognitive and emotional factors play in predicting children's physical risk taking.

Implications for Injury-Prevention

The present results may prove useful for injury-prevention programming in several ways. First, many interventions to change health behaviors focus on changing cognitions (e.g., Morrongiello, Miron, & Reutz, 1998). Expanding these to focus also on changing emotions may be an additional path to behavioral change and reduced risk taking. Research with adults and adolescents confirms that attitudinal and behavioral changes can be achieved with persuasive health messaging (Gleicher & Petty, 1992; Rothman & Salovey, 1997), including those that target emotions (Donohew, Lorch, & Palmgreen, 1991; Everett & Palmgreen, 1995), and the same may prove true for children.

Second, screening measures to assess children's cognitive and emotional responses in risk situations may help to identify those who are most likely to do risk behaviors. For example, children high in the personality attribute of sensation seeking show greater risk taking and report more excitement when risk taking, compared to children scoring low on sensation seeking (Morrongiello & Sedore, 2005). Screening to identify this high injury-risk group (cf., Morrongiello & Lasenby, 2007) would allow one to direct interventions to those most in need, thereby maximizing reductions in childhood injuries.

Third, intervention specialists may find that matching intervention parameters to child attributes is important for effectiveness. Children who respond with little fear in risk situations, therefore, may require a different type of intervention for effectiveness. Research with adolescents, for example, indicates that interventions need to be suspenseful, fast paced, and to provide arousal-evoking graphic messages to change the behavior of those who experience excitement in risk situations (Donohew et al., 1991; Everett & Palmgreen, 1995; Lorch et al., 1994; Palmgreen et al., 1991; Zuckerman, 1994). Tailoring the intervention to the unique cognitive and emotional attributes of the child may be necessary for success, if the aim is to reduce risk behaviors among school-age children.

Finally, the lack of interaction effects in the regression analysis is quite an important finding because it means that cognitions and emotions influence risk taking in the same ways for boys and girls and across a broad age range. Thus, any intervention developed that is based on the present results can presumably be applied broadly and should be comparably effective for boys and girls 7 through 12 years of age.

Limitations and Directions for Future Research

Although the present study provides unique insights into factors that influence children's risk taking, there are some limitations that need to be acknowledged and considered in planning future research. First, purposive sampling was used to recruit participants representing a broad range of income groups, but no specific measures of socio-economic status (SES) were taken. Thus, there is no way of knowing how broad the SES distribution actually was in the sample. Moreover, lack of SES information precluded our determining if predictors of risk taking vary with SES. Given that children in lower income groups can be at elevated risk of injury (e.g., Laing & Logan, 1999), it may be instructive in future research to formally measure SES so that

determinants of risk taking can be differentially assessed as a function of SES within the sample.

In addition, theoretical questions remain to be answered. For example, research with adolescents and adults suggests that risk taking reflects stable, dispositional traits (e.g., Cooper, Wood, Orcutt, & Albino, 2003). Thus, individuals respond in stable and predictable ways in risk situations that fall within one domain (e.g., financial risk taking, health risk taking), although they show variability in risk tolerance across domains (Soane & Chmiel, 2005; Weber, Blais, & Betz, 2002). Evidence that injury occurrence predicts future injury in individual children (Bijur, Golding, & Haslum, 1988; Eminson, Jones, & Goldacre, 1986; Jacques & Finney, 1994) suggests that stability in physical risk taking also might be evident in children. However, longitudinal research is needed to address this important issue and determine if high risk takers remain so across situations and over time.

Conclusions

The present results are based on how children responded in an ecologically valid risk-taking task. The findings highlight the importance of considering both cognitive and emotional contributions to children's risk-taking decisions. Children who rated danger and fear as low and excitement as high showed greater risk taking than children not showing this pattern of responding. These findings add to the growing evidence of the multi-determined nature of children's risk taking (Morrongiello & Lasenby, 2007) and they suggest that interventions to reduce children's risk taking may benefit from targeting not only cognitions, as typically done, but also emotions.

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