Age and Gender Differences in School-Age Children’s Appraisals of Injury Risk

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Objective: To examine age and gender differences in children’s perception of injury risk and to evaluate cognitive factors that relate to their appraisal of risk.

Methods: The participants were 120 children (6 to 10 years of age), who used a series of photographs, which depicted play activities that varied from no to high risk, to appraise injury risk.

Results: Children were able to distinguish varying degrees of injury risk. Boys rated risk as lower than girls, and 6-year-old children identified fewer risk factors and did so more slowly than 10-year-old children. For girls, perceived vulnerability to injury was the best predictor of injury risk ratings, whereas for boys it was judged severity of potential injury.

Conclusions: Children’s appraisal of risk and age and gender differences in related factors highlight important components for injury prevention programs.

Key words: children; injury; risk perception; risk appraisal; risk-taking behavior; injury prevention; severity; vulnerability.

Unintentional injuries constitute one of the most threatening and pervasive health problems faced by children. Childhood injuries account for 57% of all deaths of children in Canada (Canadian Council on Social Development, 1996), result in 30,000 permanently disabled children annually in the United States (Rodriguez, 1990), and are the leading cause of death among many industrialized nations in the world (Baker, O’Neill, & Karpf, 1984). Moreover, injury rates for boys after 2 years of age are two to four times greater than those for girls (Baker, et al., 1984; Canadian Institute of Child Health, 1994; Matheny, 1988). Even though injuries represent a significant pediatric health concern, pediatric psychologists have limited understanding of the factors that influence injury outcomes among children. A 1993 Task Force Report of the Society of Pediatric Psychology highlighted the need specifically to identify developmental and cognitive factors that contribute to childhood injury outcomes and injury risk (Finney et al., 1993). This is the focus of the present study.

Naturalistic observations and laboratory-based studies reveal that boys engage in more injury risk behaviors than girls (Coppens & Gentry, 1991; Ginsburg & Miller, 1982). Many explanations for gender differences in risk-taking behavior have been offered, including the notion that boys are more impulsive (Manheimer & Mellinger, 1963), have higher activity levels (Matheny, 1988), and are less willing to seek assistance (Block, 1983) than girls. However, most of these explanations are speculative. Little systematic research has examined the sources and correlates of gender differences in children’s injury risk behavior. One exception, however, is a telephone-diary study in which 6- to 10-year-old boys and girls provided daily reports on...
injury and near-injury events (Morrongiello, in press). Results revealed that boys reported more injuries than girls, were less likely than girls to worry about potential injuries, perceived their injuries as being less severe than girls, and were more likely to erroneously blame their injuries on bad luck, whereas girls assumed personal responsibility for more of their injuries. These beliefs contributed to boys being more likely than girls to repeat a behavior that resulted in injury. Thus, boys and girls differed in aspects of their beliefs about injuries, and these differential beliefs related to gender differences in injury outcome processes.

Children's perception of risk seems likely to influence their risk-taking behavior and may provide insights into gender differences in children's risk-taking and injury outcomes. Research with adolescents, for example, reveals a negative correlation between perception of risk and risk-taking behavior, with those who perceive low levels of risk to their health and safety being more likely to engage in risk-taking behaviors such as smoking, unprotected sex, and taking drugs (Lavery, Siegel, Cousins, & Rubovits, 1993). Moreover, consistent with evidence of gender differences in adolescent risk-taking, males tend to have lower perceptions of risk associated with drug and alcohol use than females (Spigner, Hawkins, & Loren, 1993). Extending these results to younger children, one might expect boys to rate injury risk lower than girls. However, relatively little is known about children's perception of injury risk and the factors that influence these perceptions.

Children as young as preschool age can reliably distinguish between safe and unsafe situations (Coppens, 1985), but whether children's appraisal of injury risk changes with age, and differs for boys and girls, remains to be determined. Morrongiello (under review) found that boys' and girls' ratings of injury risk were influenced by the facial expression of a peer modeling risk-taking behavior, but the size of the effect differed for boys and girls: a wary affect displayed by the model resulted in significantly higher risk ratings for girls than boys. The present study assessed age and gender differences in children's appraisals of risk and evaluated whether they could be predicted from certain beliefs about injuries, namely, children's beliefs about the likelihood of personal injury (vulnerability) and potential severity of injury outcomes. Research with children confirms that perceptions of vulnerability and severity are significant variables that influence their health decisions (Bush & Iannotti, 1990; Dielman et al., 1980). There is some evidence too that children's perceptions of injury severity and vulnerability for injury, at least for bicycle injuries, decreases with age and may influence their decisions about risk-taking (Peterson, Gilles, Cook, Schick, & Little, 1994). Building on these findings, this study evaluated whether children's perceptions of vulnerability for injury and severity of injury outcomes related systematically to their ratings of injury risk.

Two aspects of children's appraisal of injury risk were examined: relative risk judgments (i.e., ability to determine which of two options poses more or less risk to safety) and absolute risk judgments (i.e., estimates of how much injury risk is present in a situation). We expected that children at all ages would be good at relative risk judgments, since preschoolers can do such discriminations quite well (cf. Coppens, 1985). However, we thought that younger children might be slower than older children in appraising risk, resulting in decreasing reaction time with age for relative risk judgments. For many activities in which children engage (e.g., rollerblading, bicycling), the faster one can identify hazards, the greater the likelihood of taking a preventive action to avoid injury during the course of the activity. Consequently, reaction time to judge risk is an important parameter to consider in research on children's appraisal of risk. For judgments of absolute risk, we thought that boys might give lower ratings of risk than girls (cf. Morrongiello, under review). Furthermore, we thought there might be a decline in risk ratings across age, since children's perception of vulnerability for injury decreases over this range (cf. Peterson et al., 1994) and could result in children minimizing the degree of injury risk.

To evaluate further whether there were age or gender differences in children's appraisal of risk in situations, we asked our participants to identify all the risk factors in each situation. If boys assign lower risk ratings than girls, they may identify fewer injury hazards. Alternatively, boys and girls may identify the same hazards but weigh these differently in appraising the degree of injury risk in situations. We considered that identification of hazards might improve over age, due to any number of factors (e.g., increasing experience with the activity, improved visual analysis skills). Finally, participants were asked to generate preventive measures for hazards they identified. Children's ability to generate preventive strategies to address injury hazards in situations is likely to influence injury outcomes, yet
Children's Appraisal of Risk

Table I. Descriptions of the Photographs for Each Injury Situation

<table>
<thead>
<tr>
<th>Situation</th>
<th>No risk</th>
<th>Low risk</th>
<th>Medium risk</th>
<th>High risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stairs</td>
<td>No obstructions* child descending stairs (only foot visible), has shoe on.</td>
<td>Toys* obstruct 2 stairs; foot has shoe on.</td>
<td>Toys obstruct 4 stairs and bottom staircase; shoe untied.</td>
<td>Toys obstruct 5 stairs, bottom staircase; socks; area rug on top stair.</td>
</tr>
<tr>
<td>Bicycle</td>
<td>Appropriate use of bike and equipment.</td>
<td>Child* not wearing a helmet.</td>
<td>No helmet; high traffic area; dark, no light; apple in 1 hand, large bag in other hand.</td>
<td>2 children riding double, 1 holds bag; no helmets; high traffic area; dark.</td>
</tr>
<tr>
<td>Playground</td>
<td>2 children* appropriate use of equipments.</td>
<td>4 children; 1 going down slide while another is at bottom.</td>
<td>6 children; 1 going up ladder as 1 comes down; 1 going down slide as 1 climbs up; 1 stands at bottom.</td>
<td>5 children on slide; 2 sitting at bottom, 1 climbing up and 2 going down; not attending to activity around them.</td>
</tr>
</tbody>
</table>

*Strais are uncarpeted, glossy hardwood floors.
*Toys and objects were selected to reflect use by both boys and girls of varying ages.
*Photographs were duplicated by gender so that the children were presented the photographs with the same gender model(s).
*Boys and girls ranging in ages from 6 to 10 years of age.

littie is known about this aspect of injury prevention, or if boys are poorer at doing so than girls.

Method

Participants

Participants were 120 children: 40 children each at 6 years (M = 6 years, 6 months, SD = .4 months), 8 years, (M = 8 years, 8 months, SD = .4 months), and 10 years of age (M = 10 years, 7 months, SD = .3 months), with 20 girls and 20 boys in each age group. Participants were recruited from grades 1, 3, and 5 from six schools within the Board of Education for the city of London, Ontario. These schools were located in different areas of the city and serviced a broad range of socioeconomic (SES) groups. The children were enrolled in regular school programs and none of them had any intellectual, visual, or auditory impairments.

Measures

Risk Perception Task. We assessed children's appraisal of risk using 12 8 x 10 color photographs, 4 photographs (no risk, low, medium, and high risk relative to each other) for each of 3 situations that depicted events that commonly result in injuries for the age groups being investigated: obstructed stairs, bicycle, and playground safety (see Table I). Figure 1 presents the photographs for the bicycle situation, with a male model.

Peabody Picture Vocabulary Test-Revised (PPVT-R). The PPVT-R (Dunn & Dunn, 1981) was administered to ensure equivalent verbal skills across all participants. For this sample, standardized scores (based on age norms) on the PPVT-R indicated that children's scores were within normal range at all ages (M = 100, SD = 12.58). An analysis of variance (ANOVA) indicated no gender differences in scores. Thus, receptive vocabulary was within normal limits at all ages for both boys and girls, suggesting no differences by gender in general verbal intelligence. Any age differences found for other measures, therefore, were assumed not attributable to differences in intelligence.

Procedure

This research was approved by the Review Board for Non-Medical Research Involving Human Subjects, University of Western Ontario. Children received a letter of explanation requesting participation and a consent form to give to their parents. Children over 7 years of age and parents signed the consent form. Participants were removed individually from the classroom to participate in this study. Prior to completion of the questionnaires, the use of Visual Analogue Scales (VAS) was demonstrated and children's ability to use this scale verified. Participants then completed the Risk Perception Task, which was video-recorded, and the PPVT-R.

In completing the Risk Perception Task, participants were shown the photographs in pairwise presentation to determine their ability to make relative risk judgments. All possible pairings of photographs were presented for a total of six pairings per injury situation. The children were asked to choose either the most unsafe or the safest photograph within the
A board was placed between the child and the experimenter while the experimenter organized the pair of photographs. When ready, the experimenter asked the child to choose either the most unsafe or safe photograph, and then the board was removed.

Participants' appraisal of risk and their perceptions of severity and vulnerability were measured using VAS. In this study VAS consisted of a 160 mm line with anchors at each end point, which were defined as the extreme limits of the variable being measured (e.g., "not at all unsafe" to "extremely unsafe"). Participants were asked to mark a line on the scale to indicate their response (e.g., "how unsafe would it be for you to play here"). The child's score, which ranges from 0 to 160, was obtained by measuring the number of millimeters from the left anchor to the point at which the child marked the line. Participants were then shown each photograph individually (presented in random order) and were asked to use VAS to indicate how unsafe they judged each photograph to be (i.e., absolute risk judgments). Then for each of the photographs participants were asked to indicate anything in the photograph that was unsafe. For each high-risk photograph they were asked to generate as many injury prevention measures as they could. Using the high-risk photograph for each situation, participants were asked to use VAS to indicate the extent to which they perceived themselves to be vulnerable to injury in the situation and how severe they perceived potential injuries to be were they to engage in the risky behaviors depicted.

Figure 1. Photographs, with a male model, depicting no-risk, low-risk, medium-risk, and high-risk bicycle situations.
Data Reduction

Participants’ response times to select the correct photograph in the pairwise presentation of photographs were coded from the video-records and calculated as the time from when the children first made eye contact with the photographs to when they pointed to the photograph of their choice. Response time was scored, in milliseconds, independently by two coders with disagreements resolved by a third naive coder. A difference of 500 msec or less was considered an agreement and the average of these taken as the score. Interrater reliability, computed as the percentage agreement (i.e., the number of agreements divided by the sum of the agreements plus disagreements) ranged from .83 to 1.00 per participant, with an overall average of .96.

To assess children’s ability to identify risk factors and to generate preventive measures, we conducted a content analysis on participants’ verbatim responses to determine the common risk factors for each photograph and common preventive measures for each situation. Participants’ responses were coded and scored independently by two coders and disagreements were resolved by a third naive coder. Interrater reliability was calculated using Cohen’s Kappa coefficient (Cohen, 1960). Kappa coefficients for the coding of children’s identification of risk factors across the photographs ranged from .70 to 1.0 for the stair situation, .82 to 1.0 for the bicycle situation, and .66 to 1.0 for the playground situation, indicating a good level of agreement. Kappa coefficients for the coding of preventive measures were 1.00 for the stair situation, .81 for the bicycle situation, and .90 for the playground situation, indicating an excellent level of agreement.

Results

We used ANOVAs to evaluate between-group differences (i.e., age and gender differences). Repeated measures ANOVAs were performed to evaluate within-participant differences across the three injury situations, with follow-up ANOVAs performed when significant interactions were present. Post-hoc tests of group means were conducted using Schefé’s procedure (Scheffe, 1953).

Risk Appraisal. As shown in Table II, there were significant differences in children’s ratings of risk (i.e., absolute risk judgments) across photographs, for each situation, stair, $F(3, 342) = 475.12, p < .001$; bicycle, $F(3, 342) = 380.65, p < .001$; playground, $F(3, 342) = 268.15, p < .001$. Children’s risk ratings were significantly different among all four photographs, except in the playground situation in which children did not perceive a difference in risk between the medium- and high-risk photographs. Children’s risk ratings confirmed the relative rank ordering of the photographs within each situation, indicating that children recognized that injury risk increased as more risk factors were introduced into the situations.

While there were no age differences in risk ratings for the different situations, there were gender differences for the bicycle, $F(1, 114) = 6.87, p < .01$, and playground, $F(1, 114) = 3.79, p < .05$, situations, with girls perceiving more risk than boys (see Table III). Similarly, when an ANOVA was conducted on children’s ratings of risk averaged across all four photographs for each situation, it was revealed that girls assigned higher risk ratings than boys, $F(1, 114) = 6.51, p < .01$ ($M = 82.72, SD = 15.29$; $M = 76.86, SD = 14.78$, respectively). Overall, boys perceived injury risk to be lower than girls.

By contrast, as presented in Table IV, there were no gender or age differences in children’s ability (accuracy) to select the most safe and unsafe situation.
Table IV. Means and Standard Deviations (in Parentheses) for Study Variables, by Age and Gender

<table>
<thead>
<tr>
<th>Study variable</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>F</th>
<th></th>
<th></th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>.95</td>
<td>.95</td>
<td>.96</td>
<td>ns</td>
<td>.94</td>
<td>.96</td>
<td>ns</td>
</tr>
<tr>
<td>Response time</td>
<td>(0.07)</td>
<td>(0.09)</td>
<td>(0.08)</td>
<td></td>
<td>(1.00)</td>
<td>(1.00)</td>
<td></td>
</tr>
<tr>
<td>Severity</td>
<td>4.48</td>
<td>3.34</td>
<td>2.56</td>
<td>***</td>
<td>3.76</td>
<td>3.67</td>
<td>ns</td>
</tr>
<tr>
<td>Vulnerability</td>
<td>(1.56)</td>
<td>(1.58)</td>
<td>(1.05)</td>
<td></td>
<td>(1.36)</td>
<td>(1.49)</td>
<td></td>
</tr>
<tr>
<td>Risk factors</td>
<td>124.28</td>
<td>121.80</td>
<td>101.76</td>
<td>**</td>
<td>119.90</td>
<td>111.90</td>
<td>ns</td>
</tr>
<tr>
<td>Identified</td>
<td>(28.63)</td>
<td>(31.59)</td>
<td>(25.90)</td>
<td></td>
<td>(29.55)</td>
<td>(33.07)</td>
<td></td>
</tr>
<tr>
<td>Preventive</td>
<td>128.11</td>
<td>133.36</td>
<td>117.35</td>
<td>*</td>
<td>139.43</td>
<td>123.30</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>(.06)</td>
<td>(.06)</td>
<td>(.07)</td>
<td></td>
<td>(.06)</td>
<td>(.08)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.17)</td>
<td>(.20)</td>
<td>(.24)</td>
<td>***</td>
<td>.20</td>
<td>.21</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>(.04)</td>
<td>(.06)</td>
<td>(.06)</td>
<td></td>
<td>(.06)</td>
<td>(.06)</td>
<td></td>
</tr>
</tbody>
</table>

*Main effect for age.
*Main effect for gender.
*p < .05.
**p < .01.
***p < .001.

Table V. Partial Correlations for Age, Between Risk Ratings (Absolute Risk Judgments) and Study Variables

<table>
<thead>
<tr>
<th>Study variables</th>
<th>Risk ratings</th>
<th>Total</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk factors identified</td>
<td>.16</td>
<td>.21</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Preventive measures generated</td>
<td>.07</td>
<td>.01</td>
<td>.11</td>
<td></td>
</tr>
<tr>
<td>Severity</td>
<td>.46**</td>
<td>.51**</td>
<td>.31*</td>
<td></td>
</tr>
<tr>
<td>Vulnerability</td>
<td>.50**</td>
<td>.46**</td>
<td>.53**</td>
<td></td>
</tr>
</tbody>
</table>

*Proportion scores.
*p < .05.
**p < .01.

In a pair of photographs. Proportion scores for making such relative risk judgments approached ceiling for each situation (over .90). Thus, the gender difference in children's appraisal of risk was specific to absolute risk judgments. Children at all ages had no difficulty making relative risk judgments, and boys were as competent as girls in doing so.

Similarly, there were no gender differences in children's response times in making relative risk decisions. However, there were significant age differences, F(2, 114) = 18.50, p < .001. Six-year-old children had higher response times than 8- and 10-year-old children, indicating that 6-year-old children took longer to assess risk than 8- and 10-year-old children.

Table V shows the partial correlations, controlling for age, for the total sample and boys and girls, between children's risk ratings (averaged across the three injury situations) and the study variables. Risk ratings were positively correlated with ratings of injury severity and vulnerability. When children perceived themselves to be highly vulnerable to injury and rated the potential injury severity as high, they were likely to rate the risk to their safety as high. These relationships were statistically significant for both boys and girls.

To determine the best predictor of risk ratings (absolute risk judgments), we conducted separate hierarchical regression analyses for boys and girls. As would be expected, age was significantly correlated with most of the variables so it was entered first as the covariate, with the main effects variables entered second (only those variables that were significantly correlated with the criterion variable were included in the main effects step), and the interaction terms (i.e., the interaction of the specified variables and gender) entered last. With risk ratings as the criterion variable, ratings of injury severity and vulnerability were entered into the main effects step. For the overall sample, the regression analysis revealed a significant main effects step, F(5, 112) = 7.21, p < .001, and a significant interaction effects step, F(8, 109) = 4.68, p < .001.

For boys, ratings of injury severity were the best and only significant predictor of their risk ratings, accounting for 28% of the variance, F(4, 55) = 6.34, p < .001. In contrast, for girls, ratings of vulnerability to injury were the best and only significant predictor of their risk ratings, accounting for 21% of the total variance in their risk ratings, F(4, 53) = 3.61, p < .01.
Perceived Severity and Vulnerability. Although there were no gender differences in children's perceptions of injury severity and vulnerability, ANOVA revealed main effects for age for severity, \( F(2, 114) = 6.82, p < .01 \), and vulnerability, \( F(2, 114) = 3.93, p < .05 \). As shown in Table IV, 10-year-old children rated potential injuries to be less severe than 6- and 8-year-old children, and 10-year-old children perceived themselves as less vulnerable to injuries than 8-year-old children, with 6-year-old children's ratings being not significantly different from 8- and 10-year-old children. Children's perception of injury severity and vulnerability for injury varied too depending on injury situation, severity, \( F(2, 228) = 30.87, p < .001 \); vulnerability, \( F(2, 228) = 9.50, p < .001 \). Children perceived themselves to be less vulnerable to injuries and rated potential injuries to be less severe in the playground situation than the stair and bicycle injury situations (severity \( M = 100.42, SD = 44.43 \); \( M = 122.88; SD = 34.65; M = 124.54, SD = 34.33 \); vulnerability \( M = 115.66, SD = 42.18; M = 128.97, SD = 39.08; M = 134.47, SD = 34.32 \), respectively).

Identifying Risk Factors and Preventive Measures. For each participant, a proportion score was calculated that represented the number of risk factors children identified in relation to the total number identified (across all participants) for that particular photograph. These proportion scores were then averaged across all four photographs to yield an average proportion score for each injury situation. Overall, the proportion of risk factors identified for each situation was about 50%, with ANOVA revealing that more risk factors were identified for the stair situation than the bicycle and playground situations, \( F(2, 228) = 345.04, p < .001 \) (severity \( M = .55, SD = .08; M = .30, SD = .14; M = .26, SD = .08 \), respectively). While there were no gender differences in identifying risk factors, there was a main effect for age, \( F(2, 114) = 11.09, p < .001 \), and follow-up tests revealed that 6-year-old children identified fewer risk factors than 10-year-old children, who did not differ from 8-year-old children (see Table IV). When risk ratings and proportion of risk factors identified were correlated, the only significant correlation occurred for the playground situation, with the identification of risk factors resulting in higher risk perception ratings \( r = .25, p < .05 \). This suggests that for the stairs and bicycle situation, it was not the number of risk factors present but the type of risk factor most influenced children's perception of risk.

For all situations, most children were able to generate at least one preventive measure (to a maximum of 7). Proportion scores were calculated in the same manner as for the identification of risk factors. The proportion of preventive measures generated was low for all three situations, less than .29. ANOVA revealed a main effect for age, \( F(2, 114) = 18.53, p < .001 \), and injury situation, \( F(2, 228) = 88.72, p < .001 \). Ten-year-old children generated more preventive measures than 6-year-old children, who did not differ from 8-year-old children (see Table IV). Children generated a higher proportion of preventive measures for the bicycle situation than the stair and playground situations (M = .29, SD = .19; M = .15, SD = .06; M = .18, SD = .09, respectively).

Discussion

In this study children demonstrated their ability to recognize varying degrees of risk. However, there were significant differences in how boys and girls perceived this risk. Generally, girls rated the situations as posing more risk than boys. However, when making relative risk judgments (i.e., selecting the most safe and most unsafe situation in a pair of photographs), boys were both as accurate and as quick to assess risk as girls. Thus, gender differences in appraisal of risk was specific to children's absolute risk judgments and did not generalize to relative risk judgments.

For girls, ratings of vulnerability were the best predictor of their absolute risk ratings, whereas ratings of injury severity was the best predictor for boys. Thus, when judging risk to personal safety, girls think in terms of "Will I get hurt," whereas boys think in terms of "How hurt will I get." Peterson et al. (1994) have suggested that when children repeatedly experience near injury or minor injuries they may become desensitized to the possibility of severe injury outcomes. This investigation suggests further that differences between boys and girls in the role of vulnerability and severity in their assessment of risk could have important implications for risk-taking behavior. Girls may avoid situations in which they feel vulnerable to injury, whereas boys may proceed to take risks if they do not judge the potential injury outcome to be severe. Extending this logic, if risk-taking results in injury (even a minor one), this may be sufficient for girls to not repeat the behavior (i.e., they learn about their vulnerability for injury based on their injury
experiences), whereas injuries may not be a deterrent to future risk-taking for boys, particularly if the injury was not severe. These speculations are consistent with Morrongiello's (in press) findings that boys rate the same types of injuries as less severe than girls, and boys are more likely than girls to repeat behaviors that led to injuries previously. Clearly, further research is needed examining children's repeated risk-taking and influences on their perception of risk of sustaining injuries.

Although boys rated injury risk as lower than girls, there were no gender differences in children's identification of hazards and generation of prevention strategies. Thus, it was not the case that girls assigned higher risk ratings because they identified more hazards than boys. Rather, it seems that girls assigned different weight to these hazards, interpreting these as posing a greater risk of injury than did boys. Consistent with this view, Morrongiello (under review) found that, when appraising risk, girls assigned greater significance to cues signaling injury risk (e.g., affect displayed by a risk-taking peer model) than boys. These findings suggest therefore that simply alerting boys to the presence of injury hazards in situations may not influence risk appraisal sufficiently to deter risk-taking behaviors.

The lack of age differences in children's ratings of risk is surprising, particularly since younger children identified a fewer number of hazards than older children. Apparently, it was the nature of the hazards, and not simply the number of hazards, that influenced children's ratings of risk (i.e., judgments about degree of risk do not necessarily occur in an incremental manner with increasing number of risk factors). The lack of age trends in risk ratings suggests that decreases in perceived vulnerability for injury in the 6 to 10 years age range (cf. Morrongiello, under review; Peterson et al., 1994) does not result in distortions of children's perception of risk; that is, decreases in perceived vulnerability do not produce decreases in judged risk. Rather, children perceive the same degree of injury risk across age, but as children get older they assign less "significance" or weight to this when assessing their vulnerability to injury.

Consistent with Coppens (1985), younger children here were just as competent as older children in making relative risk judgments; however, younger children were slower in doing so than older children. Thus, in situations in which reaction time is essential for injury avoidance (e.g., bicycling), one might expect younger children to fare more poorly than older children due to their requiring a longer time to assess risk. Similarly, the fact that younger children did more poorly than older children in generating preventive measures may also place them at greater risk of injury in situations where preventive action could minimize the risk of injury.

This study addresses important questions about children's perceptions of risk and factors that predict their ratings of risk. There are some aspects of this study, however, that could be improved in future research on this topic. Children assigned risk ratings for statically depicted situations. Although children appeared to have no difficulty with the task, this format provides only a snapshot view of an injury-risk situation as a basis for their judgments. In future research it would be useful to assess for children's perception of risk using a method that demands appraisal of risk in dynamically changing situations (e.g., videotaped presentation or naturalistic settings) and provides greater sources of information that could signal risk (e.g., noise level, degree of confusion). In future research it would be helpful also to use a more unstructured interview format to allow children to explain those aspects of a situation that served as a basis for their risk judgments. In this study we asked them specifically to identify hazards, assuming these contributed to their risk ratings. However, a less structured approach might reveal that children attend to a number of sources of information in appraising risk, such as children's affect display and their own history of experience with a specific activity. Moreover, the developmental differences found in this study suggest the need for longitudinal analyses to examine the factors (e.g., injury experience, education, cognitive development, peer experiences, physical maturation) that may influence changes in children's injury beliefs over time and that may explain why some children are more likely to engage in injury-risk behaviors than others.

This investigation provides some understanding of what are important considerations with respect to injury prevention programming. The findings of this investigation support the adoption of a developmental perspective (cf.; Richards, Hendricks, & Roberts, 1991; Roberts, 1986), since there were age-related differences in identification of hazards and prevention knowledge and the speed with which
Children assessed risk. Interventions that emphasize changing children's behavior will likely be essential to promote effective injury prevention because providing information about safety hazards alone does not guarantee that children will engage in safe behavior. In fact, despite knowing that risk existed, children in this study, particularly at young ages, had difficulty generating preventive measures. Likely, children, especially young ones, are simply unable to problem-solve to identify all of the risk factors present in a situation and to generate a number of alternative preventive measures. Thus, this study highlights the need for children to learn safety behaviors or skills (for a review of behavioral approaches to injury prevention see Roberts, Fanurik, & Layfield, 1987), not simply rules. Consistent with this, several studies have found that behavior rehearsal and practice is superior to teaching children safety rules (Jones et al, 1990; Lehman & Geller, 1990). Moreover, this investigation highlights the importance of considering children's beliefs about injury risks in order to understand how they appraise risk. Older children had different beliefs than younger children about their vulnerability to injury, that is, that injury is less likely to be an outcome for them when they take risks. Thus, targeting the beliefs of older children, most optimally in combined cognitive-behavioral interventions designed to address the multifactorial nature of injuries, may be more important than for younger children, who primarily require intervention aimed at teaching them specific injury prevention behaviors. Prevention programs may also need to consider gender differences in children's beliefs about injuries. For example, although emphasizing vulnerability for injury will be useful in assisting girls to judge risk, it will be less effective than emphasizing potential injury severity with boys. In short, our findings suggest that prevention programs will be most effective if they address the multifactorial nature of childhood injuries and are matched to the developmental level of the children to which they are aimed.

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