The Role of Parents and Temperament on Children’s Estimation of Physical Ability: Links to Unintentional Injury Prevention

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Objective
Unintentional injuries, the leading cause of pediatric mortality, are caused by a complex set of intrapersonal and environmental factors. The role of three critical variables—parental supervision, children’s temperament, and estimation of children’s physical abilities—was examined. Methods Sixty-four 6- and 8-year-old children completed a laboratory experiment with a parent. Both children and parents judged the child’s ability to complete reaching, stepping, and crouching tasks. Parents also completed a parent-report measure of children’s temperament. Results Both children and parents overestimated children’s ability, although children did so more than parents. Parents of temperamentally impulsive and undercontrolled children judged that their children could complete tasks that were actually beyond the child’s ability. Temperament also affected children’s judgments while parents were present or absent. Conclusions The mechanism by which parental supervision might protect children from injury appears to be at least twofold: (a) Parents overestimate children’s ability less frequently than children themselves, suggesting supervising parents could intervene to prevent children from attempting dangerous activities; and (b) children judge their physical abilities more cautiously when parents are present. Implications for temperament theory and for injury prevention are discussed.

Key words injury; temperament; ability estimation; parenting; supervision; children.

Unintentional injuries are the leading cause of death for children ages 1–18 (National Safety Council, 2001). In 1998, 42% of the deaths among American children ages 5–14 were due to unintentional injuries; among this age group, the death rate from unintentional injuries out-numbered the death rate from the next ten causes of death combined (National Safety Council, 2001). The cost of nonfatal injuries is also staggering. Societal financial expenses are estimated at $174 billion per year, and the impact on education is estimated at 14 million lost school days annually for children ages 6–16 (National Safety Council, 1991). Despite these statistics, scientific understanding of the behavioral factors that place children at risk for injury, and therefore the means to develop empirically based interventions, remains incomplete.

The Role of Parents in Children’s Risk-Taking Behavior
Due to a range of developmental, temperamental, and cognitive factors, young children sometimes become dysregulated in their management of risk-taking behavior (Byrnes, 1998) and therefore experience increased opportunity for unintentional injury. Two risk factors proposed to contribute to dysregulated risk-taking behavior are: (a) cognitive immaturity on tasks, such as overestimation of physical ability, and (b) behavior patterns linked to temperamental traits such as impulsivity and undercontrol (Byrnes, 1998). Young children do not have fully developed cognitive strategies and therefore frequently overestimate their ability to successfully complete basic physical tasks (Plumert, 1995). Among 6-year-old chil-
Children, the tendency to overestimate physical ability correlates to history of major injuries requiring professional medical attention (Plumert, 1995) and to minor injuries incurred on a daily basis (Plumert & Schwebel, 1997). Similarly, children with impulsive and undercontrolled temperamental tendencies take risks that might contribute to unintentional injury (Schwebel & Plumert, 1999). Longitudinal research suggests that early temperamental impulsivity and undercontrol is related to later injury risk (Schwebel & Plumert, 1999).

Because adults have better-developed cognitive and impulse control skills, parental supervision is recommended as an effective strategy to prevent childhood injuries (e.g., Garling & Garling, 1993; Morrongiello, Midgett, & Shields, 2001; Peterson, Cook, Little, & Schick, 1991; Peterson, Ewigman, & Kivlahan, 1993; Wills et al., 1997). Recent research suggests that the quality and quantity of parental supervision is related to reduced history of injury (Morrongiello et al., 2001) and that parents who intervene promptly with children who engage in dangerous activities have children who take fewer risks and experience fewer injuries (Morrongiello & Dawber, 2000).

One unresolved issue is how and why parental supervision might reduce injury risk. Two possibilities emerge. First, parents might prevent children from injury by physically or verbally intervening when children begin to act in a dangerous way. If parents have cognitive skills and impulse control that are more mature than children, then parents might recognize the potential danger of a situation that children judge to be safe and could prevent children from engaging in that dangerous activity. Alternatively, the mere presence of a parent may cause children to better utilize self-correcting strategies to make safe, nonrisky decisions. In other words, children may feel pressure to behave cautiously in the presence of a parent, whereas they might behave in a more risky manner when alone (see Berndt, 1979; Smith & Howes, 1994).

Another unresolved issue is whether the efficacy of parental supervision differs across types of children. Researchers have long known that individual differences affect injury rate (Manheimer & Mellinger, 1967), but it is unclear whether the success of parental supervision might vary for children of different ages, genders, or temperamental traits. Previous work suggests that parents estimate older children's pedestrian safety (Dunne, Asher, & Rivara, 1992) and knowledge of safety rules (Yarmey & Rosenstein, 1988) more accurately than they do those of children ages 5 and 6 and that mothers of daughters judge videotaped playground situations as more risky than do mothers of sons (Morrongiello & Dawber, 2000), but the actual effect of supervision on children of different ages, genders, or temperaments is unknown.

A third unresolved issue is whether the proximity of a parent to the child influences the effectiveness of supervision (Wills et al., 1997). Little empirical work has addressed this possibility directly, although logic suggests supervision conducted from a close proximity might be more effective than distant supervision.

**Objectives of the Study**

The present study was designed to examine the above issues. Four topics were of particular interest.

**Children's Estimation of Physical Ability**

Previous work suggests that children tend to overestimate their ability to complete basic physical tasks (i.e., they judge that they can complete physical tasks that are actually beyond their ability; Plumert, 1995). Underestimation of ability (i.e., judging that they cannot complete physical tasks actually within their ability) is uncommon (Plumert, 1995). In this study, we expected to replicate these findings. We also expected that overestimation would be moderated by age, gender, and temperament: Younger children, boys, and temperamentally impulsive and undercontrolled children would have a greater tendency to overestimate ability.

**Parent's Estimation of Children's Physical Ability**

Previous work has not examined parents' estimation of children's physical abilities. In this study, we expected that parents would tend to overestimate their children's ability to complete basic physical tasks, although they would do so to a lesser degree than children. We also expected that parents would underestimate their child's ability to some degree. The role of children's age, gender, and temperament was of interest, but because little is known about these processes, no a priori hypotheses were made concerning the role of these individual differences.

**The Role of Parental Presence in Children's Estimation of Physical Ability**

The presence of a parent was hypothesized to lead children to be more cautious in estimating their own physical abilities—that is, we expected that the presence of a parent would lessen the extent of overestimation of physical ability. The role of children's age, gender, and temperament was
also of interest, but no \textit{a priori} hypotheses were made concerning the role of these individual differences.

\textbf{The Role of Parental Proximity in Parents’ Estimation of Children’s Physical Ability}

If parents were standing immediately adjacent to their children, it was hypothesized that their judgment of their children's physical ability would be more accurate than if they were watching from several feet away. Thus, increasing the proximity of the parent to the child was expected to decrease both parental overestimation and underestimation of children's physical abilities. The role of children's age, gender, and temperament was also of interest, but again \textit{a priori} hypotheses were not made.

\textbf{Method}

\textbf{Participants}

Sixty-four children (33 six-year-olds, 31 eight-year-olds; 34 boys, 30 girls) participated in a one-hour laboratory battery. Recruitment was targeted toward a wide range of ethnic and socioeconomic groups, so the sample was racially and socioeconomically diverse. The 6-year-old group had a mean age of 79.86 months (SD = 4.71), included 19 boys and 14 girls, and was 61% white, 30% African American, and 9% other ethnicities. The 8-year-old group had a mean age of 103.16 months (SD = 5.34), included 15 boys and 16 girls, and was 42% white, 48% African American, and 9% of other ethnicities (see Table I). Seven-year-olds were not included in the sample because (a) we sought to test a relatively broad range of development within a moderately sized sample but still maintain sufficient statistical power, and (b) previous research along a similar line of inquiry (Plumert, 1995; Plumert & Schwebel, 1997) used 6- and 8-year-olds but omitted 7-year-olds. Parents provided written informed consent for the study; children provided either verbal (age 6 and under) or written (age 7 and over) assent. All research was approved by the university institutional review board. Families received a small compensation for participating in the study.

\textbf{Procedure and Measures}

\textit{Estimation of Ability Task.} To assess estimation of physical ability, the accuracy of both children and parents in estimating children's ability to complete a series of physical tasks was computed. Tasks were sometimes prepared within children’s ability and sometimes beyond. In total, children completed six blocks of four tasks. A figure depicting the apparatus and a detailed explanation of the protocol is available elsewhere (Plumert, 1995). Briefly, the four tasks were the vertical reach, the horizontal reach, stepping, and clearance tasks. The vertical reach task involved removal of a small toy from a shelf while standing on tiptoes. The horizontal reach task involved reaching from a squatting position to retrieve a small toy off a block without touching hands or knees on the floor. The stepping task involved stepping from behind one stick attached to the floor over a second, parallel stick. The clearance task involved moving under a flexible bar attached to the floor over a second, parallel stick. The clearance task involved moving under a flexible bar attached to two posts without knocking the bar down or putting hands or knees on the floor.

Tasks were set at one of four difficulty levels: (1) the well-within level, 13% below children's estimated maxi-

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\hline
Measure & Age 6 (n = 33) & Age 8 (n = 31) & Total (n = 64) \\
\hline
Demographic data & & & \\
Age, months, & 79.86 (4.71) & 103.16 (5.34) & 91.15 (12.75) \\
White, % & 61 & 42 & 52 \\
Male, % & 58 & 48 & 53 \\
Accompanied by mother, % & 88 & 84 & 87 \\
\hline
Children's estimation of ability & & & \\
Tasks within ability (% judged correctly) & 97 (1) & 96 (1) & 97 (1) \\
Tasks beyond ability (% judged correctly) & 29 (24) & 42 (24) & 35 (25) \\
\hline
Parent's estimation of children's ability & & & \\
Tasks within ability (% judged correctly) & 79 (16) & 79 (17) & 79 (16) \\
Tasks beyond ability (% judged correctly) & 63 (19) & 69 (17) & 66 (18) \\
Temperament composite & 4.22 (.68) & 3.95 (.85) & 4.09 (.77) \\
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\end{tabular}
\caption{Means (and Standard Deviations) of Variables of Interest}
\label{table:variable_means}
\end{table}

\textsuperscript{a}A large majority (39% of total sample) of nonwhite participants were African American. Remaining participants were Hispanic (3% of sample), Asian American (2%), Native American (2%), and other/refused to report (3%).

\textsuperscript{b}One 8-year-old was accompanied by a custodial grandmother. All others not accompanied by mothers were accompanied by fathers.
maximum ability level; (2) the just-within level, at children's estimated maximum ability level; (3) the just-beyond level, 8% beyond children's estimated maximum ability level; and (4) the well-beyond level, 13% beyond children's estimated maximum ability level. Each task was individually scaled for each child using previously measured estimates of maximum ability (explained below) for reaching, stepping, and crouching.

Tasks that were well within and just within children's ability assessed underestimation tendencies. In other words, if children or parents incorrectly judged that a child could not complete a task that was actually within his or her ability, they were underestimating the child's ability. Although not directly relevant to risk for injury, frequent underestimation of ability might have implications for children's social and motor development (see Schwebel & Plumert, 1999). Tasks that were just beyond and well beyond children's ability measured overestimation tendencies. Inaccurate estimations that the child could complete tasks that were actually beyond his or her ability indicated overestimation of the child's ability. Overestimation of ability by children was of particular interest since it may lead to unintentional injury (Plumert, 1995; Schwebel & Plumert, 1999).

Estimates of children's maximum ability levels were obtained before the test trials in a separate room. The actions used to derive estimates of the children's maximum levels of ability were similar but not identical to those performed in the tasks. For the vertical reach maximum ability level measurement, children stood on tiptoes and reached above their head. The height of their reach was marked at the second joint of the index finger. For the horizontal reach measurement, children squatted along a line and reached forward to touch the top of the experimenter's pencil. The experimenter moved the pencil increasingly further until children could not touch it, and the maximum reach was recorded. For the stepping measurement, children stepped forward beyond the experimenter's pencil, which was placed on the floor along a ruler; the pencil was placed at increasingly far distances until children could no longer complete it and the maximum step was recorded. For the clearance measurement, children squatted down and were asked to “get as small as possible, like a ball”; the point one inch above the arch of children's backs was recorded as the maximum ability level. After estimates were taken, one experimenter prepared the apparatus in the testing room while a second experimenter conducted brief measures with children unrelated to the present hypotheses.

Once the apparatus was prepared, the experimenter led children into the testing room and gave instructions for the study. Parents learned directions simultaneously by watching the experimenter through a one-way mirror and listening on headphones attached to a microphone in the experimental room. Children were shown each of the four tasks and the experimenter explained how each was performed. Children were then presented with $12 of play money to use in the games. The experimenter explained that once children were positioned for the task, a timer would be set for 7 seconds. During those 7 seconds, children were instructed to think carefully about whether or not they could complete the task successfully. After the timer rang, the experimenter asked, “What do you think?” and children answered either affirmatively or negatively about their ability to complete the task. If children judged they could complete it, they were asked to attempt it. If they judged they could not complete it, the experimenter proceeded to the next task. Successful attempts were rewarded with an additional play dollar and unsuccessful attempts punished with the loss of a dollar. When children indicated that they could not complete the task, no money was exchanged.

During the 7-second latency, parents made their estimations about children's ability to complete the task. Parents had been previously instructed to circle their answers to two questions on a response sheet prepared for them: (a) Do you think the child will say he/she can complete the task? and (b) Do you think he/she can complete the task? Experimenters monitored parents to be sure they answered questions during the 7-second timer latency; on the rare occasion when parents responded late, those data were dropped from analyses.

Parents completed their ratings from one of two positions. For half of the six trial blocks, parents watched children from behind a one-way mirror, standing approximately 10 feet from the nearest task and 22 feet from the farthest. For the other half of the blocks, parents stood adjacent to children, within 3 feet of the task. Parental position was clumped so that the first three blocks were judged either from behind the window or standing near the child, and then the position was switched for the second three blocks. Initial parent location was randomly determined.

Each of the six trial blocks included each of the four tasks. Task order and task difficulty were randomly determined across trial blocks, with the stipulations that each child perform each task at each of six difficulty levels (i.e., once each at the well-within and well-beyond levels, and twice each at the just-within and just-beyond levels) and that each child complete each task once in each trial block. Between trial blocks, children worked with one experimenter on measures unrelated to the present hypotheses while a second experimenter adjusted the
apparatus. Parents completed the temperament questionnaire described below (“Temperament”) in a third room. This ensured that neither children nor parents would witness equipment adjustment and discover whether tasks might be easier or harder for the child. All activity in the testing room was videotaped through a one-way mirror to permit later coding.

After the six trial blocks were complete, children were permitted to “buy” prizes using the play money they had accumulated (in actuality, all children were given the same number of prizes). Children were also asked to perform the trials they had judged they were unable to complete successfully. This manipulation maintained the integrity of the game during the test trials but allowed the experimenter to determine whether tasks had been scaled correctly and to compare the accuracy of estimations with children’s actual ability.

Incorrectly scaled tasks were removed from the data prior to analyses. A task was deemed correctly scaled if the child was able to perform a task that was at the well-within or just-within levels of difficulty or was unable to perform a task that was at the just-beyond or well-beyond levels of difficulty. The mean number of correctly scaled tasks for the well-within, just-within, just-beyond, and well-beyond levels of task difficulty was 3.86 (out of 4), 6.43 (out of 8), 6.25 (out of 8), and 3.52 (out of 4), respectively. After removal of incorrectly scaled tasks, accuracy proportions were calculated by dividing the number of correct estimations by the number of correctly scaled tasks at each level of difficulty.

Temperament. Parents completed an abbreviated version of the Child Behavior Questionnaire (Rothbart, Ahadi, & Hershey, 1994), a widely used measure of child temperament with good psychometric properties (Rothbart et al., 1994; Rothbart, Ahadi, Hershey, & Fisher, 2001). Rather than asking parents to complete the entire measure, four scales that assess temperamental traits previously linked to unintentional injury (Plumert & Schwebel, 1997; Schwebel & Plumert, 1999) were included: activity level (4.84, 1.05, .88), high-intensity pleasure (4.94, 1.02, .83), impulsivity (4.45, 0.85, .81), and inhibitory control (4.89, 0.92, .84). Analyses of variance (ANOVAs) yielded no significant age or gender differences on any of the scales. Because the four scales were highly related to each other (with inhibitory control reversed, Cronbach’s alpha = .81) and because previous research suggests that all are related to risk for unintentional injury (Schwebel & Plumert, 1999), they were averaged into a single composite measure of temperamental impulsivity/inhibitcontrol for subsequent analyses. With inhibitory control reversed, the average temperament score was 4.09 (SD = .77). An ANOVA yielded no age or gender effects.

Children’s Estimation of Ability

For the well-within, just-within, just-beyond, and well-beyond levels, respectively, the mean proportion of correct judgments by children was .97 (SD = .01), .95 (SD = .01), .91 (SD = .07), and .89 (SD = .10). An ANOVA yielded no age or gender effects. To simplify analyses, scores on tasks within ability were aggregated to create a single measure of underestimation of ability, and scores on tasks beyond ability were aggregated to create a single measure of overestimation of ability. Correlations between the two within-ability scores and the two beyond-ability scores, respectively, were .47 and .62. Children were far more likely to judge ability accurately on tasks within their ability (M = .97, SD = .01) than tasks beyond their ability (M = .35, SD = .25), t(63) = 17.30, p < .01 (see Table I).

Age, Gender, and Temperament Effects. ANOVAs were conducted to test for gender and age effects on the two estimation-of-ability scores. Results suggest that girls tend to underestimate their ability (M = .94, SD = .10) more than do boys (M = .98, SD = .00), F(1, 63) = 4.26, p < .05; and 6-year-olds (M = .29, SD = .24) tend to overestimate ability more than 8-year-olds (M = .42, SD = .24), F(1, 63) = 4.16, p < .05. To test whether children’s ability estimation was related to their temperament scores, the aggregated temperament composite was correlated to children’s overestimation and underestimation scores with age and gender controlled. Surprisingly, given previous
findings to the contrary (Plumert & Schwebel, 1997; Schwebel & Plumert, 1999), both correlations were non-significant and near zero.

**Parent’s Estimation of Children’s Ability**

For the well-within, just-within, just-beyond, and well-beyond levels, respectively, parents’ mean proportion of correct estimations was .85 (SD = .19), .73 (SD = .21), .61 (SD = .24), and .72 (SD = .26). Like the children, parents were quite accurate at judging tasks well within, and to a lesser extent, just within, children’s ability; there were relatively few instances of underestimation of ability. On tasks beyond children’s ability, parents were more accurate than children, although they still overestimated on nearly 40% of tasks just beyond their children’s ability.

As was done with the children’s scores, scores on tasks within ability were aggregated to create a single measure of underestimation of ability; and scores on tasks beyond ability were aggregated to create a single measure of overestimation of ability. Correlations between the two within-ability scores and the two beyond-ability scores, respectively, were .32 and .23. Parents were more likely to judge accurately on tasks within children’s ability (M = .79, SD = .16) than on tasks beyond their ability (M = .66, SD = .18), t(63) = 3.77, p < .01 (see Table I).

**Age, Gender, and Temperament Effects.** ANOVAs to test for gender and age effects on parents’ underestimation and overestimation of children’s ability yielded no significant results. To test whether parent’s ability estimation was related to children’s temperament scores, the aggregated temperament variable was correlated to parent’s overestimation and underestimation scores, with age and gender controlled. The correlation with tasks within children’s ability was nonsignificant, r(60) = -.05, but there was a significant negative correlation between parent’s estimations on tasks beyond children’s ability and children’s temperament, r(60) = -.35, p < .01, suggesting parents of more controlled children judged children’s ability more accurately than did parents of undercontrolled children. Put differently, parents of undercontrolled children expected that the children could complete tasks that they actually could not complete.

**Comparison of Parent and Child Estimation of Ability.** To compare parent’s accuracy of estimating children’s ability with the accuracy of the children themselves, a t test for tasks within children’s ability yielded a significant difference, t(63) = 8.05, p < .01, with children (M = .97, SD = .01) judging more accurately than parents (M = .79, SD = .16). A similar test comparing estimation of tasks beyond children’s ability was also significant, t(63) = -8.80, p < .01, although in this case parents (M = .66, SD = .18) judged more accurately than children (M = .35, SD = .25).

**Children’s Estimation of Ability as a Function of Parental Presence**

T tests were conducted to test for the effect of parental presence on children’s estimation of tasks within and beyond ability. Not surprisingly, given the low rate of underestimation overall, tendency to underestimate ability was similar across conditions of parental presence and absence, t(62) = -.83, ns. On tasks beyond children’s ability, children whose parents were present in the room first tended to judge more accurately (M = .42, SD = .27) than children whose parents were absent first (M = .30, SD = .22), t(62) = 2.01, p < .05.

To further investigate the effect of condition and parental location, a repeated measures ANOVA was conducted with condition (parent present first vs. absent first) as a between-subjects factor, and estimation accuracy on tasks beyond ability during parent presence vs. absence as a within-subjects factor. It yielded a significant effect of condition, F(1, 62) = 5.93, p < .05, which was subsumed by a Condition x Estimation Accuracy interaction, F(1, 62) = 9.73, p < .01. As shown in Table II, children whose parents were present first judged 40% correctly but became more cautious afterward with parents absent (50% correct). Children who began the study with parents absent overestimated greatly (23% correct), but became more cautious with parents present (38% correct).

**Age, Gender, and Temperament Effects.** To test whether age or sex influenced the Condition x Estimation Accuracy interaction on tasks beyond ability, separate repeated measures ANOVAs were conducted with age or sex and condition as between-subjects factors and estimation accuracy on tasks beyond ability during parental presence vs. absence as a within-subjects factor. The ANOVA including sex yielded the expected main effects of age, F(1, 60) = 4.68, p < .05, and condition, F(1, 60) = 6.58, p < .05, and interaction effect of condition by estimation accuracy on tasks beyond ability during parental presence versus absence, F(1, 60) = 9.71, p < .01, but did not indicate that children of different ages reacted differently to the presence of parents. The ANOVA including sex yielded the expected

<table>
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<th>Condition</th>
<th>Group with Parents Present First</th>
<th>Group with Parents Absent First</th>
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<tr>
<td>Parents present</td>
<td>40</td>
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<td>Parents absent</td>
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main effect of condition, $F(1, 60) = 5.50, p < .05$, and interaction effect of condition by estimation accuracy on tasks beyond ability during parental presence versus absence, $F(1, 60) = 9.71, p < .01$, but did not indicate that children of different sexes reacted differently to the presence of parents.

To test whether temperamentally impulsive and undercontrolled children might be more influenced by the presence of a parent than other children, a median split created groups of high and low temperament control and a repeated measures ANOVA was conducted with condition and temperament as between-subjects factors and estimation accuracy on tasks beyond ability as a within-subjects factor. As previously found, there was a significant main effect of condition and a significant interaction effect of condition by estimation accuracy on tasks beyond ability with parents present vs. absent. Both findings were subsumed, however, by a Temperament $\times$ Condition $\times$ Estimation Accuracy interaction, $F(1, 60) = 4.05, p < .05$. As shown in Figure 1, temperamentally controlled children judged 49% of tasks beyond their ability correctly with parents present first and 47% with parents absent. Corresponding numbers for temperamentally controlled children with parents absent first were 36% and 25%. The two-way Condition $\times$ Overestimation of Ability interaction within the temperamentally controlled group was not significant in follow-up tests.

Temperamentally undercontrolled children judged 33% correctly with parents present first and then improved to 53% after their parents were absent. Those with parents absent first judged only 19% correctly initially with parents absent but improved to 41% correct with parents present in the second half of the study. The two-way interaction was highly significant, $F(1, 29) = 12.54, p < .01$. Thus, among the temperamentally controlled children, the presence of a parent had little effect. Among temperamentally undercontrolled children, however, the presence of parents had a great effect, including a lasting effect in the group whose parents were initially present and then departed.

Learning Effect. One limitation of the above analyses is that they do not account for learning that might occur: That is, children might learn from the early tasks and therefore perform better on later tasks regardless of whether parents were present or not (Plumert, 1995). To test for this possibility, a repeated measures analysis of covariance (ANCOVA) was conducted with estimation accuracy on tasks beyond ability during the first half of the tasks versus the second half of the tasks as a within-subjects effect, and condition (parents present first vs. absent first) covaried. The main effect of estimation accuracy was not significant, indicating that children did not judge the first and second half of the tasks differently after covarying for the effects of condition. There was a main effect of condition, $F(1, 55) = 5.89, p < .05$, with children whose parents were in the room first judging more accurately across the study than children whose parents were absent first.

In summary, it appears that the presence of a parent reduced children's overestimation of ability. The effect of parental presence persisted over the course of the study for those children whose parents departed after half of the study was complete. This pattern was particularly true for children who were temperamentally impulsive and undercontrolled. It did not seem to be affected by children's age or gender, and it occurred beyond the effect of children learning to complete tasks more accurately over the course of the experiment.

Parent's Estimation of Children's Ability as a Function of Proximity to Child

Next, we considered whether parent's estimation of children's ability differed depending on the location of par-
ents. A t test comparing parent’s estimation of tasks within children’s ability yielded a significant difference: Parents were more accurate at judging tasks within children’s ability when they were standing directly next to children (M = .82, SD = .18) than while watching children from several feet away through a one-way mirror (M = .74, SD = .25), t(63) = 2.47, p < .05. The corresponding t test comparing parent’s estimations of tasks beyond children’s ability was not significant, t(63) = .22.

To further investigate the finding on parents’ estimation of tasks within children’s ability, a repeated measures ANOVA with condition (parent present first vs. absent first) as a between-subjects factor and estimation accuracy of tasks within children’s ability while near children (present) versus behind the window (absent) as a within-subjects factor was conducted. It yielded the expected effect of estimation accuracy, but the interaction effect was not significant.

**Age, Gender, and Temperament Effects.** A repeated measures ANOVA was conducted with age and condition as between-subjects factors and parents’ estimation accuracy of tasks within children’s ability while near children versus behind the window as a within-subjects factor. It yielded the expected main effect of location of the parent, F(1, 60) = 6.05, p < .05, as well as an interaction effect of condition by age, F(1, 60) = 4.93, p < .05. Further investigation of the interaction effect suggested that parents of 6-year-olds who were in the room first estimated 81% of tasks within their children’s ability accurately while parents of 6-year-olds who were behind the window first estimated 76% of tasks within their children’s ability accurately. Parents of 8-year-olds showed the opposite pattern: Those in the room first estimated 72% of tasks within children’s ability correctly while those behind the window first estimated 85% of the tasks correctly.

A similar repeated measures ANOVA was conducted with sex and condition as between-subjects factors and estimation accuracy of tasks within children’s ability while parents were near children versus behind the window as a within-subjects factor. It yielded just one significant effect, a Sex × Condition × Location of the Parent interaction, F(1, 60) = 4.73, p < .05. Parents of boys correctly judged 87% of the trials when they were in the room first, but only 70% of the trials when they were behind the window. When they were behind the window first, parents of boys judged correctly on 82% of the tasks while in the room and 80% of the tasks while behind the window. A follow-up repeated measures ANOVA with the sample of boys, using condition as a between-subjects effect and parent location as a within-subjects effect, yielded the expected main effect of location, F(1, 32) = 4.39, p < .05, but the interaction was not significant.

Parents of girls showed a different pattern. For parents of girls who were in the room first, they correctly judged 74% of tasks correctly in the room and 74% of tasks when behind the window. Parents of girls who were behind the window first judged 72% of tasks correctly behind the window and 86% of tasks correctly while in the room. A follow-up repeated measures ANOVA with the sample of girls, using condition as a between-subjects effect and parent location as a within-subjects effect, yielded no significant results. Thus, although many of the trends did not reach traditional significance levels, parents of boys underestimated the most when behind the window, particularly after being in the room first. Parents of girls underestimated more frequently than parents of boys, except when they were in the room after underestimating from behind the window.

A final repeated measures ANOVA was conducted with condition and temperament as between-subjects factors and estimation accuracy of tasks within children’s ability as a within-subjects factor. It yielded a significant main effect of estimation accuracy, but this effect was subsumed by a significant Temperament × Estimation Accuracy interaction, F(1, 60) = 9.41, p < .01. As shown in Table III, parents judged temperamentally controlled children with approximately the same accuracy whether they were in the room (M = .78, SD = .19) or behind the window (M = .80, SD = .22). For children rated as temperamentally undercontrolled, however, parents were far more accurate at judging ability while standing near children (M = .86, SD = .17) than while watching from behind the window (M = .69, SD = .27).

**Learning Effect.** To ensure that learning did not affect parent’s ratings over the course of the study, a repeated measures ANCOVA with estimation accuracy of tasks within children’s ability on the first half of the tasks versus the second half of the tasks as a within-subjects effect and condition (parents present first vs. absent first) covaried yielded a main effect of estimation that was subsumed by an Estimation Accuracy × Condition interaction, F(1, 62) = 6.06, p < .01. Parents who were in the room first averaged a mean of .81 (SD = .21) tasks judged correctly during the first half of the study, while parents behind the window averaged .74 (SD = .19).

**Table III.** Percentage of Tasks Within Children’s Physical Ability that Parents Judged Correctly by Child Temperament

<table>
<thead>
<tr>
<th>Child’s Temperament</th>
<th>Parents Near Child</th>
<th>Parents Behind Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controlled</td>
<td>78</td>
<td>80</td>
</tr>
<tr>
<td>Undercontrolled</td>
<td>86</td>
<td>69</td>
</tr>
</tbody>
</table>
first averaged a mean of \( .76 (SD = .26) \) tasks judged correctly during the first half. During the second half of the study, the proportion of tasks judged correctly were reversed: Parents who were in the room first judged a mean of \( .72 (SD = .25) \) tasks correctly while behind the window during the second half; parents who were behind the window first judged a mean of \( .84 (SD = .15) \) correctly while in the room for the second half. This pattern is not surprising: Stated simply, parents judged tasks within children's ability more accurately while in the room, and very little learning occurred over the course of the study.

In summary, results from the analyses of parent estimation suggest that parents were more accurate on tasks within children's ability while standing next to the children compared with standing behind the one-way mirror. This was particularly true for parents of children who were temperamentally impulsive and undercontrolled and for parents of girls who had previously underestimated their girls' ability from behind the window.

**Discussion**

Results suggest that both children and parents overestimate children's physical abilities, although children do so to a greater extent than parents. Children, and in particular temperamentally undercontrolled children, overestimate to a lesser degree while parents are in the room. Parents, and in particular parents of temperamentally undercontrolled children, underestimate children's ability more frequently while standing several feet away.

**Parental Supervision, Temperament, and Children's Ability Overestimation**

Injury scholars generally concur that parental supervision is among the best means to prevent childhood injuries (Garling & Garling, 1993; Morrongiello et al., 2001; Peterson et al., 1991, 1993; Wills et al., 1997), but the present results are among the first to empirically address how and why parental supervision might increase children's safety. Results suggest the mechanism is at least twofold: a) Parents more accurately identify children's physical limitations, and so presumably intervene to prevent dangerous activities; and b) children engage in environments with greater caution when parents are present, and this effect persists even after parents leave the environment. The contribution of each factor depends on temperament. The first, that parents can intervene to prevent injury, seems somewhat more important for temperamentally controlled children, while the second, that children behave differently in the presence of a parent, seems somewhat more important for temperamentally undercontrolled children.

Along with poor parental supervision, temperament is among the most implicated of risk factors for children's unintentional injuries (Manheimer & Mellinger, 1967; Matheny, 1986; Schwebel & Plumert, 1999). The pathway by which an impulsive, undercontrolled temperament might lead to injury risk is proposed to include multiple direct and mediated pathways (Schwebel & Plumert, 1999). One mediated pathway that has been proposed is that overestimation of physical ability might mediate the relation between temperament and injury: Children who are temperamentally undercontrolled might overestimate their physical ability, which in turn leads to injury (Schwebel & Plumert, 1999). The present results suggest parental supervision might influence that mediated pathway, since impulsive and undercontrolled children tend to overestimate ability less frequently in the presence of a parent. If so, there are important implications to injury prevention: Parental supervision might prevent temperamentally at-risk children from overestimating their physical ability, which in turn might prevent those children from injuring themselves.

Another way to conceptualize the role of temperamental differences in injury risk is to consider Temperament \( \times \) Environment interactions. Extending the early “goodness of fit” model advocated by Thomas and Chess (1977), temperament theorists (Wachs & Kohnstamm, 2001) and empiricists (Bates, Pettit, Dodge, & Ridge, 1998; Schwebel, Brezausek, Ramey, & Ramey, in press) have recently emphasized the importance of considering Temperament \( \times \) Environment interactions as predictors of children's behavior. Parents generally recognize that the intensity of parental supervision should vary based on the dangers in the child's immediate environment. Thus, for example, young children are thought to need careful supervision in the yard because it poses a high degree of risk for injury (Peterson et al., 1993). The present results suggest that perhaps supervision should vary not just in response to the setting the child is engaging in but also in response to the individual differences of children. Some children—temperamentally controlled 6-year-olds or most 13-year-olds, for instance—do not need careful supervision in playrooms that parents have prepared for safe play. On the contrary, other children—temperamentally undercontrolled 6-year-olds or most 3-year-olds, for instance—need relatively careful supervision in all areas of the home, including the playroom. Thus, the interaction between the setting the child engages in and any individual difference(s) within the child might both contribute...
Although most of the results from this study replicate and support previous work, one result was surprising and fails to replicate previous work: Children's temperament was unrelated to a tendency toward overestimation. Previous work found both concurrent (Plumert & Schwebel, 1997; Schwebel & Plumert, 1999) and longitudinal (Schwebel & Plumert, 1999) links between temperamental impulsivity/undercontrol and overestimation of ability. It is difficult to speculate what might have led to the present findings. They may be spurious, due to peculiarities in this sample. They may also represent the fact that children's overestimation of ability is likely driven by a wide range of intrapersonal, interpersonal, and environmental factors—with temperament playing only a modest role.

This study has limitations. Most prominently, it was a laboratory-based experimental study. Although the experimental design provides the opportunity to examine behavior in a controlled manner, it also presents drawbacks. The consequences for erroneous judgments of physical ability in our laboratory were minimal for children (loss of a play dollar) and essentially nil for parents (emotional reactions in what most parents engaged in as a mildly competitive activity). In real-world environments, where consequences for mistakes are greater, children and parents might be more cautious and therefore err more frequently on the side of ability underestimation (Rosenstock, 1974). Further, the experimental design led to the opportunity to conduct a large number of analyses and therefore elevated the experiment-wide risk of Type I error.

Future directions warrant discussion, in closing. This study contributes to an important trend in injury research: How do multiple risk factors, influencing children through developmental stages, contribute to risk for unintentional injury? Longitudinal studies are sorely needed. They might follow individual differences (e.g., temperament, gender), social influences (e.g., parental supervision, peer relations), cognitive influences (e.g., children's estimation of physical ability), and community influences (e.g., socioeconomic status, race/ethnicity) with the objective of identifying how these factors interact to place particular children at increased or decreased risk for injury. Beyond further examination of etiological factors, empirically based research on the role of supervision in injury prevention would be valuable. How can parents be trained to supervise their temperamentally impulsive and undercontrolled children more closely? What type of supervision is sufficient to keep children safe? Finally, future research should continue to balance controlled laboratory-based studies such as the present one with studies having greater ecological validity.
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