A Comparison of Children’s and Adults’ Judgments of Action Capabilities in Virtual Environments

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Introduction

Adults’ accuracy of affordance judgments in immersive virtual environments (IVEs) is similar to that of the real world.1 Gap-crossing estimates are body-scaled and can be altered by risky contexts or body-based changes in IVEs.2 Fear and exposure to high heights can influence judgments of gap-crossing abilities in IVEs.3 Children, whose bodies are rapidly changing, show mixed results of affordance judgments.4,5 Children may judge affordances differently, compared to adults, in IVEs.

Hypotheses

H1. Children’s gap-crossing estimates will scale less accurately to their body capabilities compared to adults.

H2. Participants will underestimate gap-crossing ability at high heights due to perceived risk.

H3. Children will underestimate less at high height because they are more likely to accept risky behavior.

Methods

Participants:
Thirty seven participants were recruited. Twelve children (9-12 y/o; 6 female), 13 teens (13-17 y/o; 6 female), and 12 adults (19-32 y/o; 6 female).

Apparatus & Materials:
The HTC Vive was used to display an IVE of an Italian piazza. Inside the piazza, participants stood on the ground plane on a brick platform adjacent to second brick platform with a gap in between. Gap width changed from trial to trial and ranged from .55 m to 1.45 m (adults and teens) and .5 m to 1.15 m (children). Each gap was presented twice. After the first 20 trials, participants were transported to a platform 15 m off the ground. Gap trials were repeated with the same widths. Three questions (0-100 scale) were asked prior to each block of trials.1) How afraid are you of the height where you are standing? 2) How likely are you to fall if you attempt to step across the current gap? 3) Before each block, participants answered questions about perceived risk.

The Corsi Block-Tapping task, which tests spatial working memory, was administered.2 It was administered after the VR task.

Procedure

For each participant, estimated maximum gap-crossing width was calculated using a cross-over method and scaled to both actual step length and eyeheight. 3) (children, teens, adults) x 2 (ground plane, 15 m) repeated measures ANOVAs were used to assess the effects of age and height on gap crossing estimates.

Results

Significant main effect of height of perceived risk questions. No significant effect of age on perceived risk questions. No significant interaction.

Scaling to Actual Step Length

Age: Significant main effect of age
F(2, 34) = 5.32, p < .010, ηp² = .238
Children: M = .83, SE = .04
Teens: M = .96, SE = .03
Adults: M = .97, SE = .04

Height: Significant main effect of height
F(1, 34) = 17.68, p < .001, ηp² = .342
Ground: M = .96, SE = .02
15 m: M = .88, SE = .02

Scaling to Eyeheight

Age: No significant main effect of age
F(2, 34) = 1.93, p < .16
Children: M = .65, SE = .03
Teens: M = .74, SE = .03
Adults: M = .69, SE = .03

Height: Significant main effect of height
F(1, 34) = 18.07, p < .001, ηp² = .347
Ground: M = .72, SE = .02
15 m: M = .66, SE = .02

Individual Differences: Corsi Block-Tapping Task

A One-Way ANOVA revealed a marginally significant main effect of age on Corsi Block-Tapping task scores, F(2, 31) = 2.66, p = .086.

Children: M = 42.17, SE = 2.94
Teens: M = 53.10, SE = 5.86
Adults: M = 60.33, SE = 7.52

Children scored significantly lower than adults (p = .029), but did not differ from teens (p = .20). Teens and adults did not differ (p = .39).

Discussion

H1: Children’s estimates, when scaled to actual step ability, were significantly lower than teens and adults, but there was no difference when scaled to eyeheight.

H2: Gap-crossing estimates were more conservative at 15 m compared to ground plane.

H3: But there was no difference between age groups.

Conclusion

Children may not be as accurate at relating visual information in the environment to their actual actions but are closer to adults in the ability to implicitly interpret the visual information with respect to their eyeheight.

This may indicate that children use different decision criteria for affordance judgments compared to teens and adults.

Future work should assess both affordance judgments and executed actions across age groups.

References


Appendix

Table 1: Values are mean scores from 0-100 scale.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Ground</th>
<th>0.66</th>
<th>4.16</th>
<th>3.50</th>
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<tbody>
<tr>
<td>Child</td>
<td>0.63</td>
<td>4.16</td>
<td>3.50</td>
<td></td>
</tr>
<tr>
<td>Teen</td>
<td>0.66</td>
<td>4.16</td>
<td>3.50</td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td>0.66</td>
<td>4.16</td>
<td>3.50</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Values are mean scores from 0-100 scale.*