Introduction

Despite being proficient tool users, and tool makers after instruction, young children display surprising difficulty in innovating tools (manufacturing a novel tool to solve a problem) (Beck, Apperly, Chappell, Guthrie & Cutting, 2011). The present studies extended this finding to a new task and explored whether 4- to 7-year-olds’ tool innovation difficulty could be a consequence of mental inflexibility.

3 explanations for tool innovation difficulty were explored:
1. Children find it difficult to move on from unsuccessful ideas and so become “stuck in set”.
2. Children are capable of innovating tools but are prevented from doing this due to task pragmatics or permission issues.
3. Tool innovation is an intrinsically difficult “ill-structured” problem.

The Tasks

Children were presented with the apparatus below (counterbalanced). They were told ‘if you can get the sticker out, you can keep it, here are some things that can help you’. Children were then given the displayed materials.

Hooks Task

Aim: Retrieve bucket from tube to get sticker.
Solution: Bend pipe cleaner into a hook.

Unbending Task

Aim: Push ball out of tube to get sticker.
Solution: Unbend pipe cleaner to make it long enough.

Experiment 1

Investigated the role of switching in the 2 tool innovation tasks which required ‘opposite’ solutions. This tested the idea that 4- to 5-year-old (N = 24) and 6-to-7-year-old (N = 27) children may become “stuck in set”.

Results

<table>
<thead>
<tr>
<th>Age Group (Years)</th>
<th>N</th>
<th>Before Demonstration</th>
<th>Only after Demonstration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hooks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 to 5</td>
<td>24</td>
<td>2 (8%)</td>
<td>19 (79%)</td>
</tr>
<tr>
<td>6 to 7</td>
<td>27</td>
<td>8 (30%)</td>
<td>18 (67%)</td>
</tr>
<tr>
<td>Unbending</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 to 5</td>
<td>24</td>
<td>8 (33%)</td>
<td>14 (58%)</td>
</tr>
<tr>
<td>6 to 7</td>
<td>27</td>
<td>15 (56%)</td>
<td>11 (41%)</td>
</tr>
</tbody>
</table>

• Hooks results comparable with previous findings.
• Although easier to achieve (McNemar, p = .011), success rates for the unbending task are low.
• No effect of task order (Fisher’s Exact Tests: Hooks, p > .999; Unbending, p = .781).
• Children did not perseverate on successful techniques across tasks.
• Children displayed low levels of perseveration within tasks.
• Children easily succeeded after a demonstration of the relevant action.

Experiment 2

Minimized the likelihood of permission or pragmatics playing a role in children’s poor performance on the tool-innovation tasks by telling children they needed to make something with the materials.

• Significant improvement with age for both tool innovation tasks (Chi-square tests: Hooks, p < .001; Unbending, p = .004).

• However, the instruction to make something did not aid children in tool innovation.

Discussion

• Results support findings of Beck et al. (2011), and extend to a new tool innovation task.
• Experiment 1 suggests that children’s tool innovation difficulties may not derive from difficulty with switching between alternative Solutions.
• Experiment 2 suggests that tool innovation difficulties cannot be explained by task pragmatics or permission issues.

References: