**Verbal Imprecision in Mathematical Explanations as an Indicator of Learning**

Katherine L. McEldon, Ran Liu & Bethany Rittle-Johnson

Vanderbilt University

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**Current Focus**

Are disfluencies in self-explanation responses indicators of learning?

**Verbal Disfluency & Learning**

As students learn a new domain, they must construct a schema or mental model of the domain and problem solving procedures. These must be iteratively revised as learning occurs.

- An impasse occurs when the step the learner believes should be executed next cannot be performed (Van Lehn, 1988).
- Speakers use umh and um to implicate when they are searching or deciding about what to utter next (Clark & Fox Tree, 2000).
- Learning is thought to occur at these impasses (Van Lehn, 1988).

**Method**

- **DOMAIN:** Mathematical equivalence is the principle that two sides of an equation represent the same value.
- **Foundational for algebra** (Falkner, Levi, & Carpenter, 1999): $3 + 5 = 6 = 6$
- 117 2nd through 4th graders with less than 75% correct at pretest on conceptual and procedural knowledge of mathematical equivalence.

**Pretest**

One on One Intervention Immediate Posttest Delayed Retention Test

**Self-Explain (n = 39)**

Solve 6 problems

**Control (n = 39)**

Solve 6 problems

**Additional-Practice (n = 39)**

Solve 12 problems

**Practice Problems**

<table>
<thead>
<tr>
<th>Conceptual Knowledge</th>
<th>Procedural Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 + 3 = 9</td>
<td>3 + 6 = 9</td>
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<tr>
<td>6 + 3 = 9</td>
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**Self-Explanation Prompts**

- Why does [7] make this a true number sentence?
- What should you pay attention to know that [7] makes the number sentence true?
- What does the equal sign mean in this problem?
- What should you pay attention to to know that the equal sign belongs here?

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**Procedure**

**Accuracy Feedback**

**Math Eq. Problem 1**

**Strategy Report**

**Accuracy Feedback**

**Self-Exp. Prompts 1 & 2**

**Math Eq. Problem 2**

**Strategy Report**

**Accuracy Feedback**

**Self-Exp. Prompts 3 & 4**

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**Results**

**Conceptual Knowledge**

<table>
<thead>
<tr>
<th>Percent Correct</th>
<th>Fluent</th>
<th>Disfluent</th>
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<tbody>
<tr>
<td>60</td>
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<td>60</td>
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<tr>
<td>70</td>
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<td>80</td>
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**Assessment Components**

**Conceptual Knowledge**

- **Explicit:** Equal Sign Knowledge
- What does the equal sign mean?

**Procedural Knowledge**

- **Learning Items:** Same as those practiced during the intervention
- **Transfer Items:** Different from those practiced during the intervention

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**Post & Retention Tests**

**Conceptual Knowledge**

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**Summary**

Elementary students who were verbally imprecise have better problem solving skills at post and retention tests than those who had precise explanations.

When students are prompted to self-explain, they engage in a learning process where they move from an initial imperfect understanding of equivalence to a correct understanding. Verbal imprecisions, such as saying ‘umm’, pausing, or requiring addition prompting from the experimenter, may indicate a conflict between their initial imperfect mental model and the correct one. Processing this conflict, as evidenced by verbal imprecision, may help them perform better on solving learning items and more difficult items after intervention.

“When children are imprecise while explaining...[we presume they are] in the process of rejecting old, presumably inefficient or ineffective problem-solving approaches.” (Perry & Lewis, 1999)

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**References**


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**Contact**

Katherine L. McEldon
katherine.mceldon@vanderbilt.edu

Vanderbilt University, Nashville, TN

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**Acknowledgments**

The work was supported by a dissertation improvement grant awarded by the Institute of Education Sciences (No. R305B080025) and Dr. Bethany Rittle-Johnson’s Awardee of the Spencer Foundation’s National Research Foundation Postdoctoral Fellowship. The opinions expressed here are those of the authors and do not represent views of the Institute of Education Sciences, U.S. Department of Education, or the US Government. This material is based upon work supported by the National Science Foundation under Grant No. SBE-0237143 awarded to Dr. Katherine L. McEldon. The authors thank the members of the dissertation committee for their helpful feedback.

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Society for Research in Child Development, April 2013, Seattle WA