How First Graders with Low Language Skill Solve Math Word Problems
Katie Humbert, Department of Communication Sciences and Disorders
Vicki Samelson, Ph.D., Department of Communication Sciences and Disorders
University of Wisconsin – Eau Claire   Eau Claire, Wisconsin

Abstract

Using an existing videotaped data set, we identified, described, and coded strategies that 20 first graders with low oral language skill used to solve basic arithmetic word problems. To establish reliability, a second student coded 20 percent of the files. Children’s strategies and future directions will be discussed.

Aims & Methods

To date, no one has described the solution strategies employed by children with low oral language skill while they solve basic arithmetic word problems.

Aims:

- Identify, describe, and code the strategies that first graders in the lowest quartile of oral language skill used to solve basic arithmetic word problems
- Establish the reliability of the coding system.

Methods:

- The primary investigator viewed 40 video files, described the children’s solution strategies and errors, and then expanded an existing coding system.
- Three sources of evidence were used to describe and code the strategies and errors:
  1) The child’s verbal ‘answer’ to each problem
  2) The child’s explanation of how he/she solved the problem
  3) Any strategies observed in the child’s use of the manipulatives that were provided for each problem.
- The principle investigator and second author collaborated to reach agreement on a set of 9 codes.
- A second undergraduate student, trained in coding arithmetic word problem tasks, independently recoded a randomly selected subset of the 40 video files (8 files, representing 20 percent of the data).
- Point-to-point agreement between the principal investigator and the independent coder was calculated for each of the coding categories.

Results & Discussion

Results:

- The following 9 strategies and errors were identified and coded:
  - Accurate conceptualization of the problem – The child shows a conceptually accurate understanding of his/her solution/strategy.
  - Calculation/count errors - The child makes an error in counting or calculating his/her response.
  - Wrong operation errors - The child subtracts instead of adding.
  - Wrong assignment errors - The child assigns an incorrect number to one of the characters.
  - Given-number strategy - The child provides one of the numbers given in the problem as his/her response.
  - Zero strategy - The child’s response is “0” for problems containing the wording “fewer than”.
  - Question-first strategy - Under the reworded + gesture condition, the child assigns a random quantity before hearing the rest of the problem.
  - Remainder strategy - The remainder of the manipulatives are assigned to the second character.
  - Unknown strategy - Specific strategy could not be identified.

** Bolded strategies were not previously identified in the literature.

Reliability: An inter-rater reliability analysis using the Cohen’s Kappa statistic was performed (Kappa = 0.825, (p < 0.001)). This result represents a very good level of reliability.

Anecdotal Observations:

- Under the reworded condition when “You need to figure out how many…” was read, some children quickly assigned a random quantity of manipulatives to the character named. This observation lead to the identification of the question-first strategy
- Under the traditional wording condition, some children, upon hearing “fewer than”, chose “0” as their answer. Some children even answered “0” without hearing the rest of the word problem. This observation lead to the identification of the zero strategy.

Future Directions:

We were able to construct a coding scheme that reliably identified the child’s solution strategies and errors, which will now allow us to test the following hypotheses:

- Children with low oral language skill will choose different strategies to solve basic math word problems than typically developing children.
- Children with low oral language skill will use a greater variety of strategies than children who are typically developing.
- Under the traditional wording with no gesture condition, children with low oral language skill will interpret “fewer than” as meaning zero.

Selected References:


Acknowledgements:

Dr. Vicki Samelson
Alyssa Yanzick
This study was supported by the UW-Eau Claire Differential Tuition Fund.