



Does Oral Language Skill Influence How First Graders Solve Arithmetic Word Problems?



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Abstract

This is a retrospective re-analysis of a videotaped data set. First graders with average, low-average, and low oral language skill solved word problems under four scaffolding conditions: traditional wording, reworded, traditional+gesture, and reworded+gesture. Group differences in choice of solution strategy and flexibility of strategy use were analyzed and discussed.

Background

- Arithmetic word problems are difficult for all children; even more so for children with low oral language skill (Cowan, Donlan, Newton, & Lloyd, 2005; Samelson, 2009).
- If we can better understand how children with low oral language skill solve word problems, we can design interventions to improve their problem solving skills and comprehension of curriculum language.
- Children generate strategies to solve problems, and depending on the nature of the task and the goals of the child, certain strategies are 'selected' and used (Siegler, 2005).
- "It has long been known that different people use different approaches; however, trial-by-trial assessments have also revealed that the same person often thinks about the same type of problem in multiple ways, especially during learning experiences" (Siegler, 2005).
- Children choose different strategies based on the accuracy with which they interpret a problem (Alibali, 2005), and typically developing children often resort to preferred default strategies when not sure how to interpret a word problem (Cummins, 1991).
- Children with low oral language skill demonstrate less-flexible cognitive processing (Pena, Resendiz, & Gillam, 2007), so these children might become entrenched in using non-productive strategies for solving word problems.
- This project is an extension of prior research (Samelson, 2009; Humbert and Samelson, 2010), where children solved word problems under 4 scaffolding conditions. The strategies used by 20 first graders with low oral language skill to solve basic arithmetic word problems were identified and described:

Strategy	Description
Accurate conceptualization of the problem	The child shows a conceptually accurate understanding of his/her solutions 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."
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 or the manipulatives leftover from the problem are assigned as the answer.
Unknown strategy	Specific strategy could not be identified.

Aims & Methods

Methods:

The primary investigator viewed 74 video files and coded the solution strategies and errors for three groups of first graders:

- Children with average oral language skill
- Children with low-average oral language skill
- Children with a diagnosis of language impairment

The oral language skills of the children in groups 2 and 3 fell in the lowest quartile of language ability.

Three sources of evidence were used to describe and code the children's strategies and errors:

- The child's verbal 'answer' to each problem
- The child's explanation of how he/she solved the problem
- Any strategies observed in the child's use of the manipulatives that were provided for each problem

The current study aimed to:

- Code a new portion of the existing data set and test statistically if group differences exist in first graders' flexibility in selecting solution strategies while solving traditionally-worded problems.
- Recode the scaffolding condition data set and test statistically if, when gesture and rewording scaffolds are presented, children with low oral language skill select different solution strategies than when traditionally-worded problems are presented.

Hypotheses:

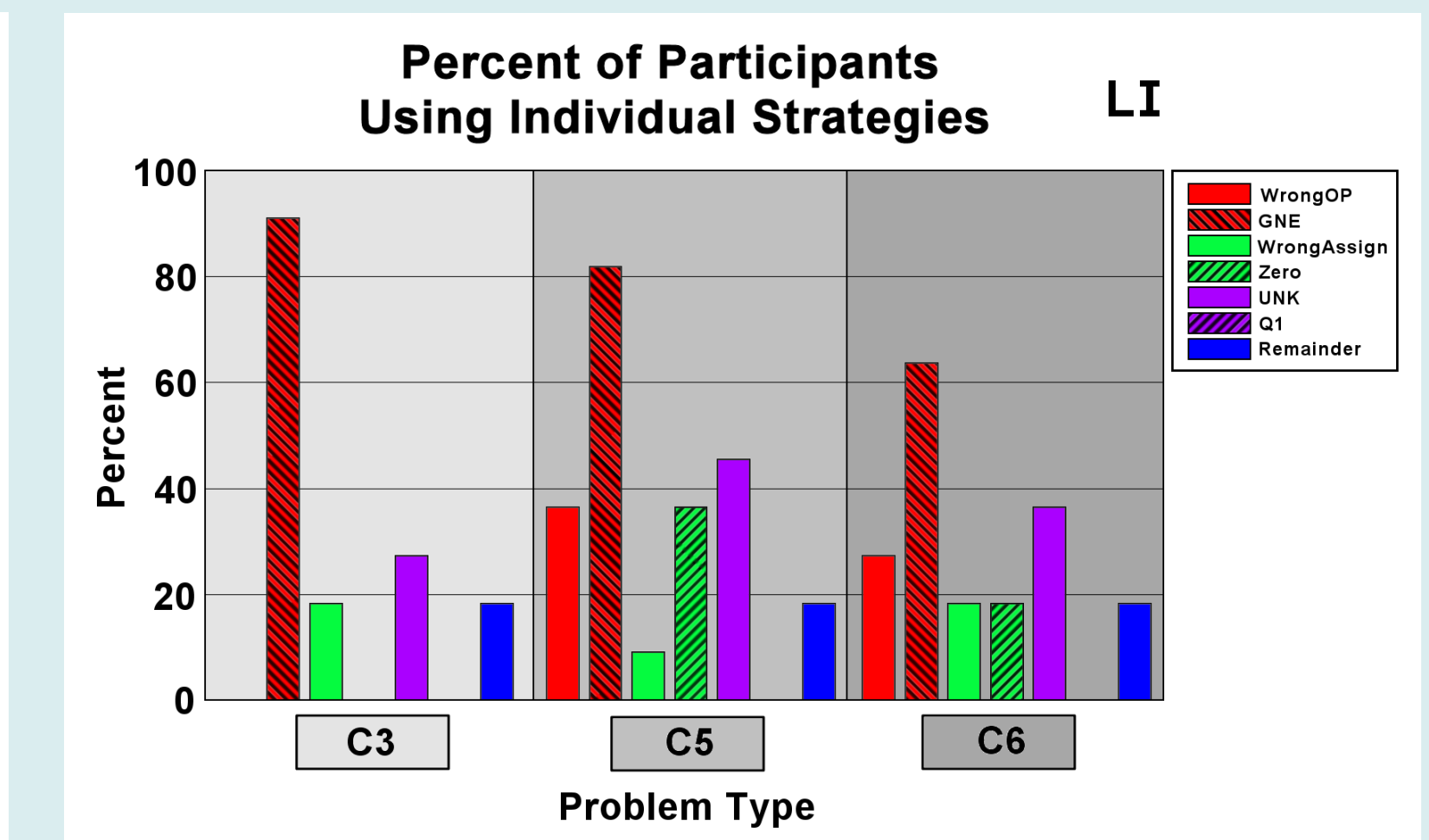
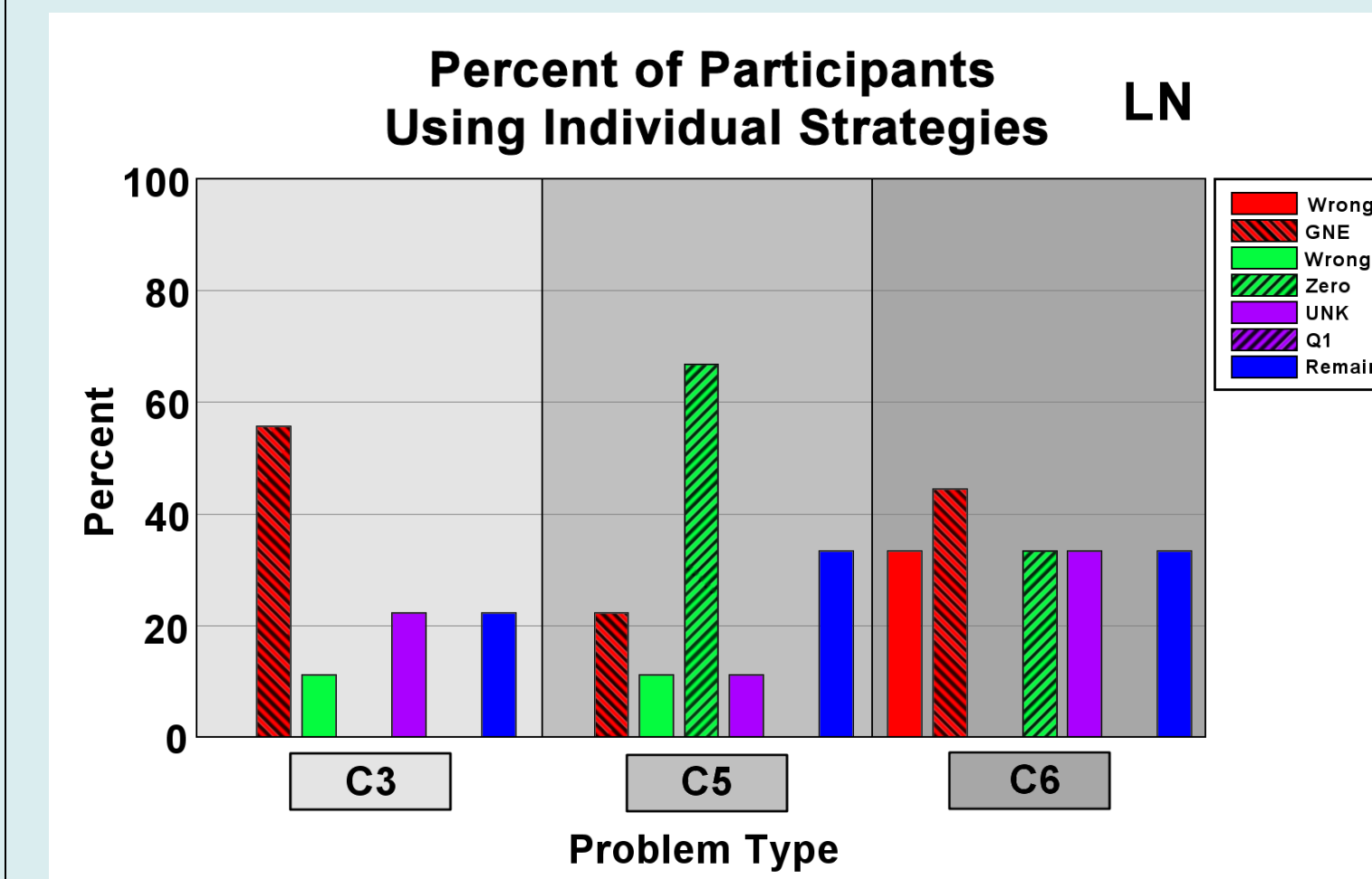
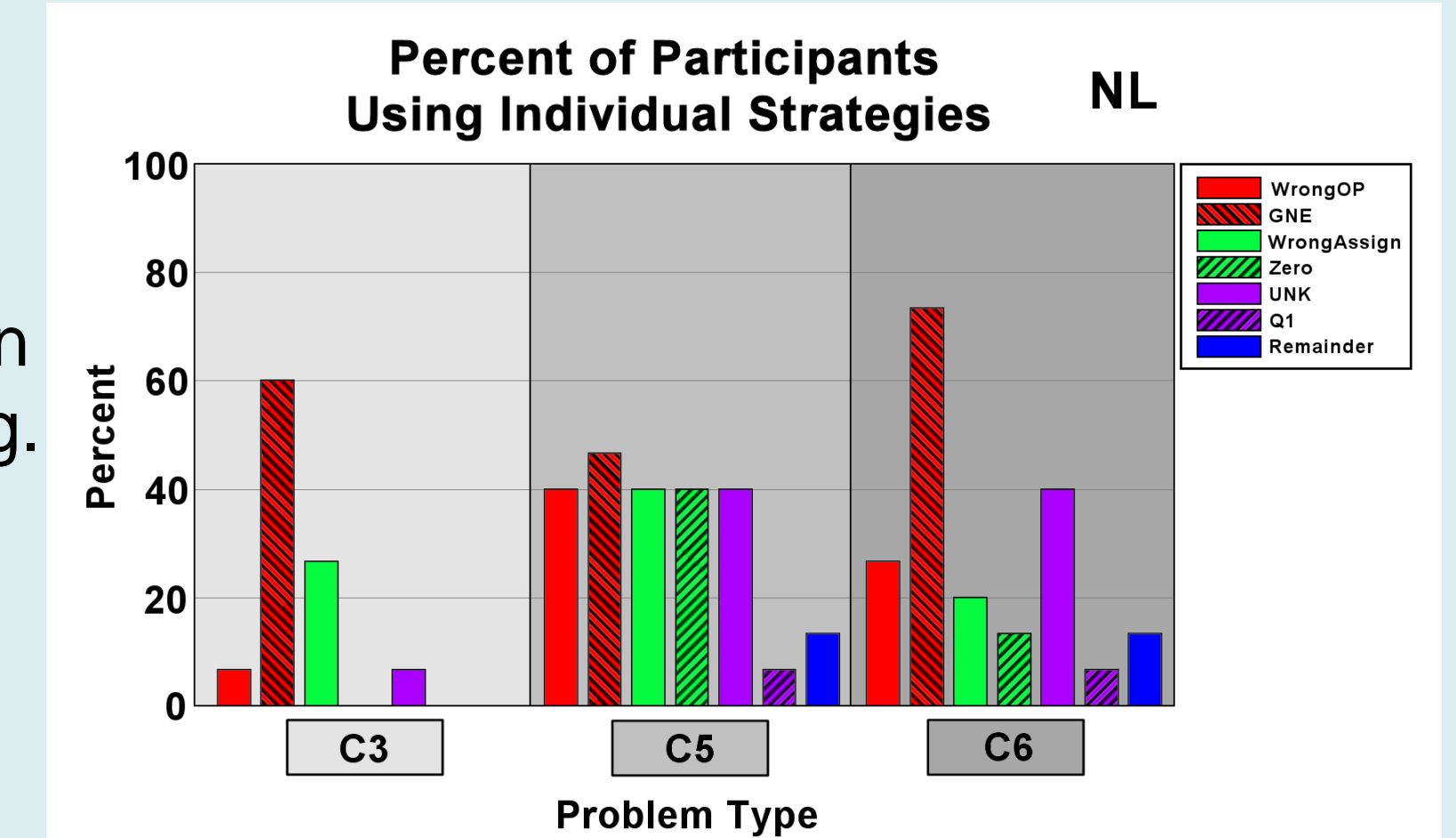
- First graders with average oral language skill use solution strategies more flexibly than their peers in the lowest quartile of oral language skill
- First graders with low average oral language skill use solution strategies more flexibly than their peers with a diagnosis of a language impairment
- First graders in the lowest quartile of oral language skill use different strategies when solving *Compare 6* word problems under rewording and gesture scaffold conditions than under a traditionally-worded scaffold condition



Results & Discussion

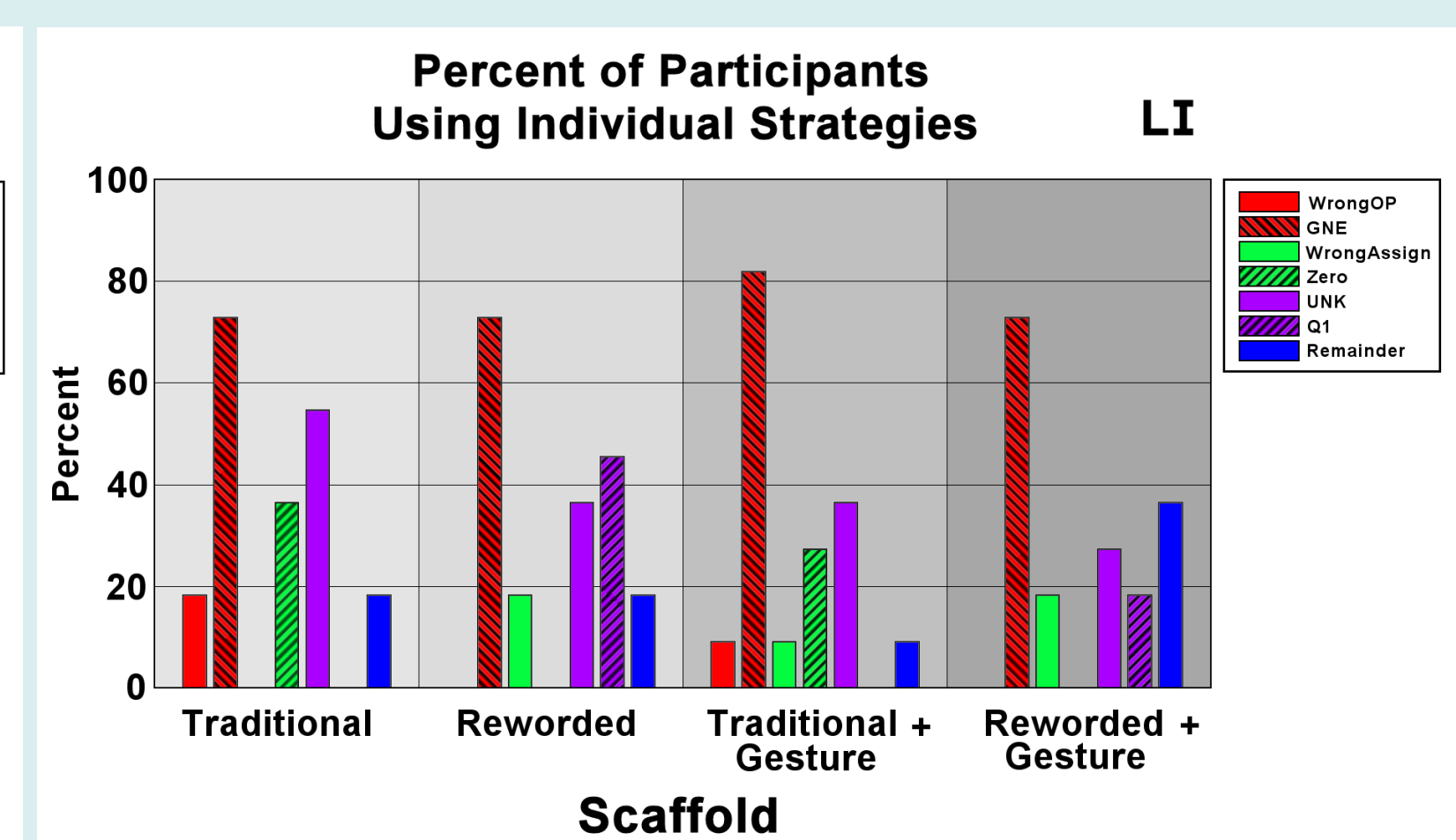
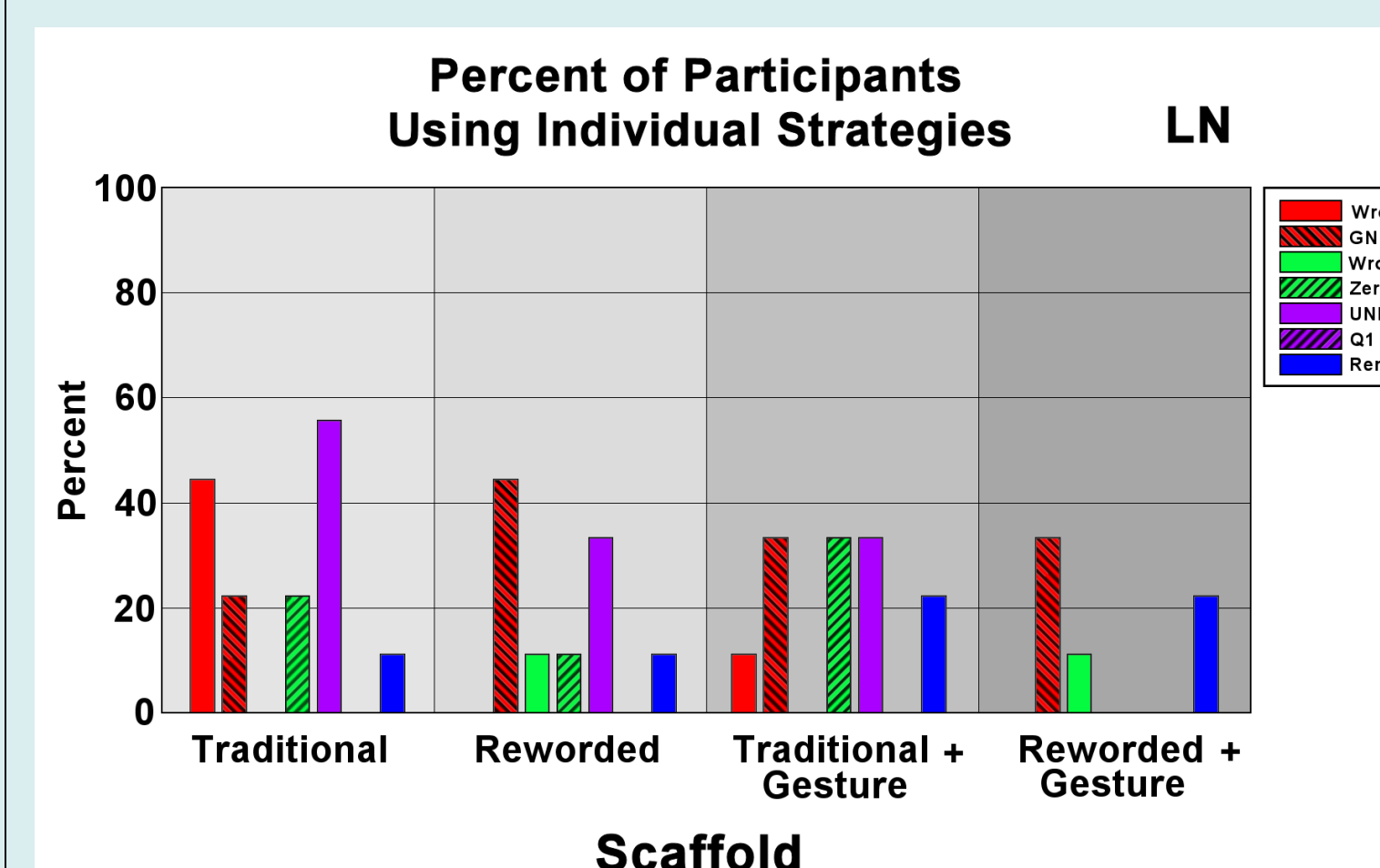
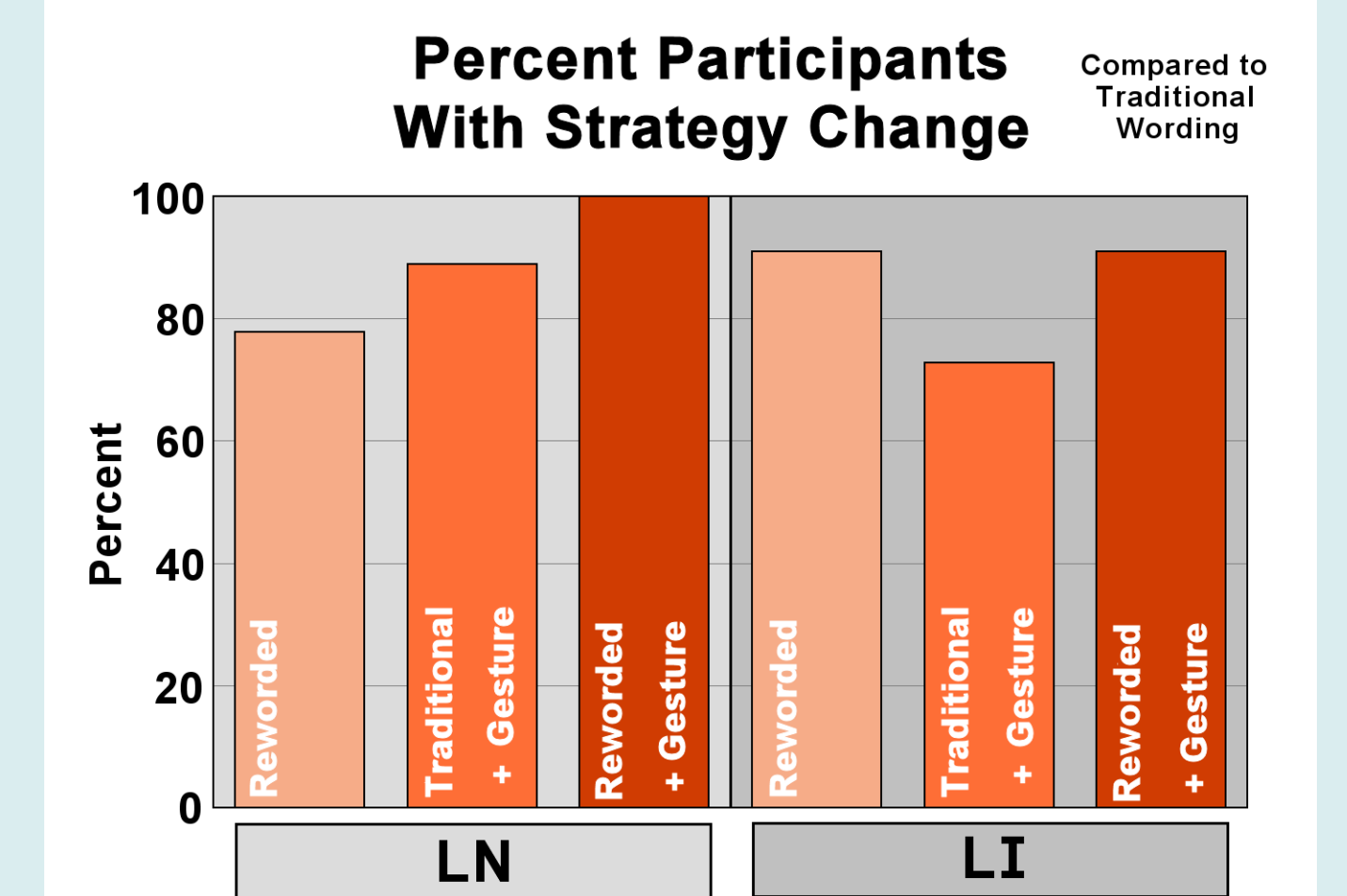
Problem Type Results:

- No overall group differences in flexibility of strategy use.
- More types of error strategies used in problems with more-difficult wording.
- Given number error (GNE) was the most common strategy overall.
- More children with language impairment used the GNE strategy.



Scaffold Results:

- The low normal (LN) and children with a language impairment (LI) both had a change in error strategies with reworded and gesture scaffolds.
- More children with LI used the GNE strategy.
- We found group and scaffold differences on Question First, Zero, and Wrong Operation errors.



Conclusions:

- All three groups of children used strategies flexibly. A few individuals did not.
- The wording of problems influenced the strategies children used to solve the math problems.
- More types of error strategies were used in problems with more-difficult wording.
- Rewording and gesture scaffolds changed the way children thought about the problems and the strategies they used.

Future Directions: A study to identify intervention approaches that decrease the amount and types of error strategies.

Selected References:

Alibali, M. W. (2005). Mechanisms of change in the development of mathematical reasoning. In R. Kail (Ed.) *Advances in child development and behavior*, (Vol. 33, pp. 79-123). New York: Elsevier Academic Press.

Cowan, R., Donlan, C., Newton, E. J., & Lloyd, D. (2005). Number skills and knowledge in children with specific language impairment. *Journal of Educational Psychology*, 97(4), 732-744.

Cummins, D. D. (1991). Children's interpretations of arithmetic word problems. *Cognition and Instruction*, 8(3), 261-289.

Humbert, K., & Samelson, V. M. (2010). How First Graders with Low Oral Language Skill Solve Math Word Problems. *Communication Connection: Newsletter of the Wisconsin Speech Language Hearing Association*.

Samelson, V. M. (2009). *The influence of rewording and gesture scaffolds on the ability of first graders with low language skill to solve arithmetic word problems*. Doctoral dissertation, University of Iowa. Available online at <http://ir.uiowa.edu/etd/>.

Siegler, R. S. (2005). Children's learning. *American Psychologist*, 60, 769-778.

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