**Introduction**

A number of studies in the psychological and educational literatures have examined the issues associated with learning and solving word problems (see Kintsch & Greeno, 1985; Mayer & Hegarty, 1996 for reviews). However the number of studies examining the role of working memory and word problem solving is small, with most studies concentrating on arithmetic word problems. Much less is known about the contributions of working memory and reading abilities to the performance of more complex mathematical tasks such as solving algebraic word problems.

How do algebraic and arithmetic word problems differ? The most salient difference is that in algebraic word problems the unknowns are treated as knowns. Singapore primary children are taught to use the model method to solve arithmetic as well as algebraic word problems. In algebraic word problems, rectangles represent unknowns whilst in arithmetic type word problems, the rectangles are known values.

To draw the model, it is necessary for children to read the question presented as text (T), translate this information presented in the textual mode into a cohesive structure known as the model (S). Next, to solve the problem, children translate the information embedded in the model into a set of arithmetic procedures (P). We hypothesise that strong linguistic skills are needed for each phase of the translation process – Text to Structure (TS) and from Structure to the Processes (SP).

Gustavo has 3 balls and Nina has 5 balls. How many balls do they have in all?

Gustavo: I have 3 balls.
Nina: I have 5 balls.

Gustavo: Nina, take one ball from me, and you will have the same number of balls as I have.

Nina: OK, I have 3 balls now.

What is the total number of balls?

**Method**

Please refer to Paper B1-60. The contributions of working memory, language, and intelligence to individual differences in algebraic word problem solving for details on participants, material and procedure.

Children were asked to use the model method to solve the ten items.

Types of Errors for Mathematics Performance Tasks

There were three levels of analysis for the mathematics task.

Level 1 - The word problems were first scored for overall accuracy.

Level 2 - A correct solution was credited with full TS, SP and Computation (C) scores.

TS score was awarded if a response had a correct model but erroneous translation into procedures.

SP score was awarded if a wrong model was constructed but the translation based on the constructed model was correct.

Partial TS and SP scores were awarded if part of the model was correct and the translation was appropriate for those parts.

Examples of children’s responses are provided in Table 1.

**Discussion**

Children with greater central executive function were more accurate in both the translation tasks, TS and SP.

Also children with higher performance IQ and better literacy skills were more successful in these two translation tasks.

Children with greater central executive function demonstrated greater accuracy in their computation skills. Neither performance IQ nor literacy skills were significant contributor to children’s ability to translate algebraic word problems. One reason for this finding could be because children are well drilled with arithmetic sums that are highly competent to complete such tasks. This would suggest that these children would score highly if they were given a test comprising purely of computation sums.

That literacy skills is an important contributor factor towards success in both levels of translation is not surprising. Good command of language is needed to understand what is presented in the question in text mode.

Furthermore language is needed to translate the mathematical information in test mode into pictorial forms as children articulate relational information into appropriate shapes and also how to organize the shapes into a coherent whole in the form of a suitable model.

At the next level of translation, SP language is again needed to translate information presented in the model into arithmetic operations. For example, a equal rectangles placed below another should be translated as four times as many and therefore the operation needed could be multiplication or division.

Performance IQ is a contributory factor towards success suggests that children who can manipulate shapes are likely to translate the model into the correct model and also from the model into the correct set of arithmetic procedures. This suggests that children who are better able to process pictorial information are likely to be able to organize information into pictures, possibly they are able to visualize the model to be in their minds.

Perhaps children with better central executive function, literacy skills and performance IQ may be more successful in the way they organize, visualize and hold the information presented in the questions, hence explaining for their success in these algebraic word problems.

**Conclusion**

The implications of these findings on pedagogy is significant.

Knowledge of pure computation skills does not mean success in algebraic word problem solving. Rather children who can articulate their thoughts verbally and pictorially are more likely to succeed in such tasks.

The findings suggest that children need to understand what they read and to articulate their understanding into words, verbally as well as pictorially.

Children need to be exposed to activities where they use language to articulate arithmetic expressions verbally as well as pictorially.

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