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Gesturing with hands is a powerful tool for children's math learning

Children who use their hands to gesture during a math lesson gain a deep understanding of the problems they are taught, according to new research from the University of Chicago's Department of Psychology.

Previous research has found that gestures can help children learn. This study in particular was designed to answer whether abstract gesture can support generalization beyond a particular problem and whether abstract gesture is a more effective teaching tool than concrete action.

"We found that acting gave children a relatively shallow understanding of a novel math concept, whereas gesturing led to deeper and more flexible learning," explained the study's lead author, Miriam A. Novack, a PhD student in psychology.

The study, "From action to abstraction: Using the hands to learn math [1]," is published online by *Psychological Science*.

The researchers taught third-grade children a strategy for solving one type of mathematical equivalence problem, for example, 4 + 2 + 6 = ____ + 6. They then tested the students on similar mathematical equivalence problems to determine how well they understood the underlying principle.

The researchers randomly assigned 90 children to conditions in which they learned using different kinds of physical interaction with the material. In one group, children picked up magnetic number tiles and put them in the proper place in the formula. For example, for the problem 4 + 2 + 6 = ___ + 6, they picked up the 4 and 2 and placed them on a magnetic whiteboard. Another group mimed that action without actually touching the tiles, and a third group was taught to use abstract gestures with their hands to solve the equations. In the abstract gesture group, children were taught to produce a V-point gesture with their fingers under two of the numbers, metaphorically grouping them, followed by pointing a finger at the blank in the equation.

The children were tested before and after solving each problem in the lesson, including problems that required children to generalize beyond what they had learned in grouping the numbers. For example, they were given problems that were similar to the original one, but had different numbers on both sides of the equation.

Children in all three groups learned the problems they had been taught during the lesson. But only children who gestured during the lesson were successful on the generalization problems.

"Abstract gesture was most effective in encouraging learners to generalize the knowledge they had gained during instruction, action least effective, and concrete gesture somewhere in between," said senior author Susan Goldin-Meadow, the Beardsley Ruml Distinguished Service Professor in Psychology. "Our findings provide the first evidence that gesture not only supports learning a task at hand but, more importantly, leads to generalization beyond the task. Children appear to learn underlying principles from their actions only insofar as those actions can be interpreted symbolically."

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The University of Chicago
Edward H. Levi Hall
5801 South Ellis Avenue
Chicago, Illinois 60637
(773) 702-1234

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