Wobbly no more: Work on analogical processing helps children learn key engineering principle

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Credit: Robert Kraft/public domain

Children love to build things. Often half the fun for them is building something and then knocking it down. But in a study carried out in the Chicago Children's Museum, children had just as much fun learning how

to keep their masterpieces upright—they learned a key elementary engineering principle.

"The use of a diagonal piece provides stability in a construction," said Dedre Gentner, lead author of the study and the Alice Gabrielle Twight Professor of Psychology and Education at Northwestern University. "We knew that children needed help to learn this, because in the Museum's 'skyscraper construction' activity, children often made buildings that collapsed immediately."

Using analogical comparison methods, the researchers devised a two-minute demonstration that proved very effective with the children.

They encouraged children to compare two model buildings—one with a brace and one without a brace. Based on their prior work, the researchers hypothesized that children who compared the two buildings would notice this key feature, even without explicit instruction. Furthermore, they predicted that children would be more likely to gain this insight if they could easily align the two buildings and see their common and distinctive parts.

To test these predictions, they had three groups of children, ranging in age from 6 to 8 years old. One group saw the high-similar pair, (see study for figures) which shows a braced building on the right and an unbraced building on the left. A second group saw the low-similar pair. Although this pair also contains a braced and an unbraced building, it should be harder for children to align; thus they may be less likely to gain insight from this pair. A third group received no training.

When a child entered the study, they were shown a pair of buildings—either a high-similar pair or a low-similar pair—and asked, "Which building is stronger?"

"Children were initially random in their responses, confirming our suspicion that they did not understand the Brace principle," said Gentner, who serves as director of Northwestern's Cognitive Science Program.

"Then we asked the child to wiggle them and find out. When they did so, they found that the unbraced building could be bent nearly to the ground, but the braced building could hardly be moved. All children then confirmed that the braced building was stronger."

But had children truly grasped this insight, the researchers wondered? The results indicate that they had.

"When they went on to build their own skyscrapers with their families, children who had received comparison training were significantly more likely to put in diagonal braces than those who had not," Gentner said. "As a final test of children's knowledge, just before the study ended, we took each child aside and showed them a building with no brace, saying, "This building is wobbly. Can you show me where to put this piece to make it strong?"

The results were striking. The no-training group performed at chance. Even after the construction task, they had not gained insight into the Brace principle, the researchers found. Children who received low-similarity (harder to align) pairs did better, but even at 8 years old, they were only 60 percent correct. But children who had received the high-similarity (easy to align) pairs showed that they had grasped the key Brace principle: over 80 percent of the 8-year-olds placed the piece diagonally, whereas 8-year-olds without training performed at chance.

"Our findings reveal ways to support children's learning both in school and in informal environments such as museums and play situations," Gentner said. "Analogical comparison is a natural and engaging process for children."

In further studies, the researchers found that strategic use of language can enhance children's ability to gain from comparison experience.

More information: "Rapid Learning in a Children's Museum via Analogical Comparison" will be published in *Cognitive Science*.

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