Positive Transfer and Analogical Problem Recognition in Four-Year-Old Children: Mathematical Perspectives

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Background

- Children often use analogies in their daily lives to make sense of the world.
- As children begin formal education, analogy is a tool used in attempt to help them develop mathematical skills.
- However, how young children respond to analogies that they did not create themselves remains poorly understood.
- They have been shown to recognize and apply analogies in certain settings, especially if there is enough surface similarity between two problems.
- Here, we explore this ability in an educational math context.

Questions

Q1. Are preschoolers able to recognize analogies?

Q2. When they have recognized an analogy, are they also able to use it to solve a problem?

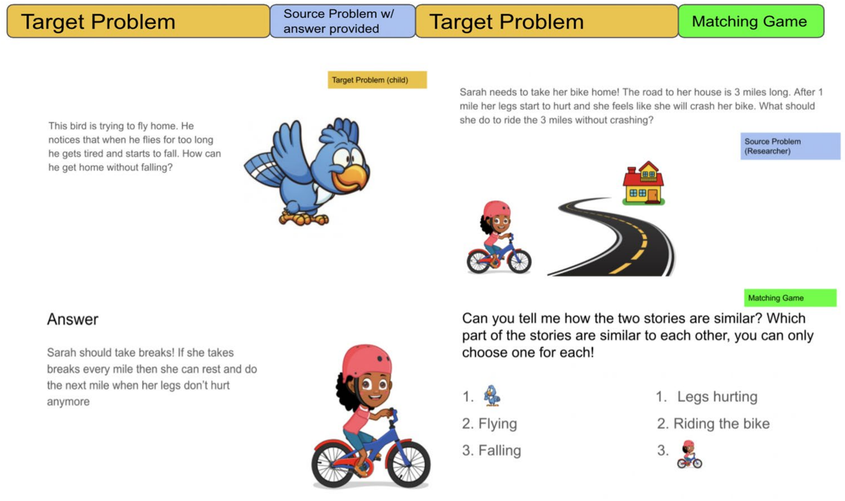
Q3. Does the level of concreteness of the source problem affect the success in recognizing and using the analogy?

References:

1. Richland, L. E., Morrison, R. G., & Holyoak, K. J. (2006). Children's development of analogical reasoning: Insights from scene analogy problems. Journal of experimental child psychology, 94(3), 249-273.
2. Glady, Y., French, R. M., & Thibaut, J. P. (2017). Children's failure in analogical reasoning tasks: A problem of focus of attention and information integration?. Frontiers in Psychology, 8, 707.
3. Gick, M. L., & Holyoak, K. J. (1983). Schema induction and analogical transfer. Cognitive psychology, 15(1), 1-38.

Methods

- Participants: 18 children ages 48-60 months
- 15-minute game over Zoom, composed of 3 question sets with 2 problems per set.
- Each question set is composed of a target problem and a source problem. One problem is concrete (uses numbers/geometry) and the other one more abstract (story with no numerical component)
- Missing the first attempt and correctly answering the second attempt is counted as a successful "Positive Transfer"
- Analogical recognition is finally tested via a matching task.

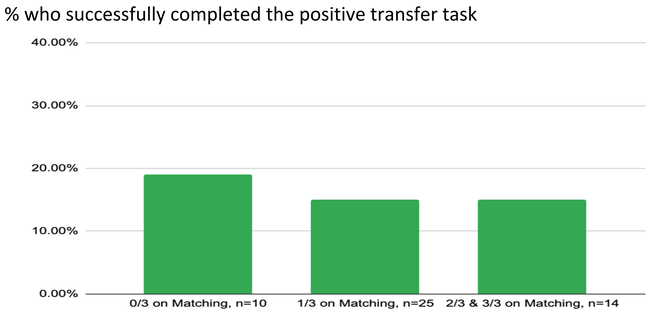


1st question set: duration over time.
2nd question set: combining shapes and counting the number of sides.
3rd question set: approximating numbers with the commutative principle. The order of presentation for concrete vs abstract was counterbalanced between participants.

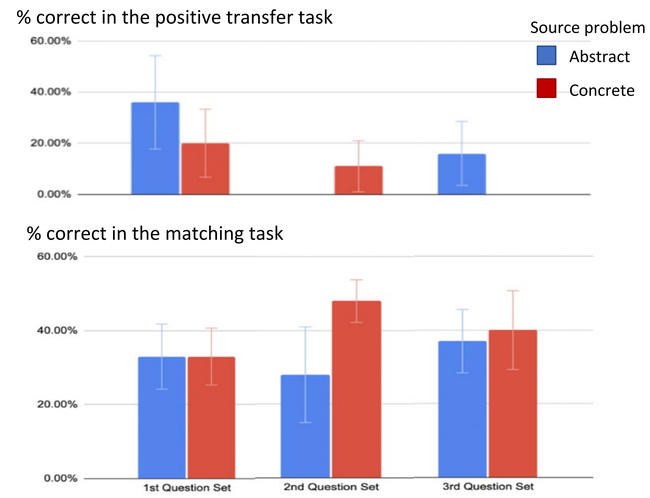
Results

Q1. The average score on the matching task was 0.37 which is roughly ⅓ components matched.

Q2. Link between recognizing and using analogies:



Q3. Effect of the level of concreteness on performance:



Conclusions/Future Directions

- Our results suggest that 4-year-old children struggle to recognize teacher-led analogies.
- The majority of children failed to use analogies, for all questions combined positive transfer only took place 14% of the time.
- Recognizing and using the analogies seemed independent.
- For the duration/time analogy, performance improved when the source problem was abstract, only in the positive transfer task.
- For the geometric analogy, performance improved on both analogical recognition and positive transfer when the source problem was concrete.
- Whether a meta-intervention about analogies would help children of this age requires further investigation.