Data-Driven Analysis of Physical and Mental Rotation Strategies

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Abstract

Studying physical rotation (i.e., rotation tasks during which figures can be physically rotated, such as through gestures) can offer insights also into problem solving processes at work during mental rotation. We present a novel method for behavioral pattern analysis which we applied to data from 2,999 physical rotation tasks gathered in-class from 50 secondary school students. The method uses normalized, resampled, time-dependent data on angular offsets between figures over time and agglomerative, correlation-based clustering. Each cluster represents a distinct behavioral pattern and its respective prototype a problem solving strategy. Results indicate that multiple strategies were employed: The dominant strategy matches the classical model of mental rotation, in which angular offsets between figures are decreased over time. For the secondary strategy, angular offsets were actually increased. A subsequent analysis shows that the secondary strategy was more frequently used for symmetric figures, possibly indicating problems with correctly matching segments across figures.

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