How do the salience and strength of existing relational representations impact analogical reasoning ability in children?

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How do existing schema representations of relational structures influence children's analogical reasoning ability? Individual differences such as relational knowledge and maturation of executive functioning have been argued to constrain children's analogical reasoning ability (Gentner, 2005; Richland, Morrison & Holyoak, 2006), as well as the structural features of analogy problems themselves (Gentner & Markman, 1997). We wish to argue that there are other key factors constraining analogical reasoning ability, including the richness of existing relational structure schemas in the child's mind, and their salience within the context of a given task or goal.

We view relational schemas as category-like and script-like representations formed from overlapping fragmented representations, instantiated in shared neural activation, and constructed / made salient through the context of a given task or goal. Several lines of theory and research support this view, including theoretical accounts that argue representations are fragmented (Barsalou, 1999; Mareschal et al., 2007), behavioural and computational work demonstrating category membership characterised by the relational structure of an object's features (Mareschal, French & Quinn, 2000) and behavioural and computational work demonstrating that category membership is contextually defined (Barsalou, 1983; Thomas, Purser & Mareschal, 2012).

Without such representations already existing in the mind and made salient through context, we argue that the ability to analogically reason with similar structures may be hindered. Take for example the ability to understanding that the head of state in one country shares analogous roles as the head of state in a different country. This rests upon the existence of the relational schema category of 'state'. Once such a relational schema exists, it is possible to further enrich the schema from the information unique to each member of the category, and furthermore, to be able to analogically reason across analogues through inference and priming. We argue that children's developmental growth in analogical reasoning ability is in part due to the richness and (contextually determined) salience of their existing relational schemas.

We present data from an initial study to evaluate this hypothesis. A category-learning task is used to enrich and increase the salience of children's relational schemas for specific relational structures. In the learning phase, children ranging in age from 5 to 9 years categorise pictorial scenes within a supervised learning paradigm. Each pictorial scene is composed of animals and objects in one of two relational structures, with group membership characterised by the relational structure illustrated within the scene. In the subsequent testing phase of the experiment, we assess the same children's ability to analogically reason with two types of pictorial analogy problems. The analogy problems are composed of either (a) scenes containing the same relational structures as those used in the category-learning task, or (b) scenes containing different relational structures as those used in the category-learning task.

We evaluate the following predictions: First, children will make more analogical matches in the problems involving relational structures enriched and made salient in the category-learning task compared to untrained relational structures. Second, to the extent that analogical reasoning ability rests upon the existence categorical relational schemas, those children showing a higher number of errors in the category-learning task (indexing impoverished existing relational schemas) will perform more poorly when analogically reasoning with the same relational structures.

Lastly, we outline a subsequent program of studies to evaluate the following questions: To what extent does language support analogical reasoning by highlighting context-specific relational schemas? To what extent does priming effect both the attentional focus on relational structure and the salience of object features and attributes within a relational structure?

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