

Metaphorical Developing Minds: The role of multiple Factors in the Development of Metaphor Comprehension

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Metaphor understanding is traditionally thought to emerge late in childhood or even adolescence (Winner, 1988/1997), although recent findings suggest that even pre-schoolers can understand metaphor in perhaps more age appropriate paradigms (e.g. Özçaliskan, 2005). In any case, one wonders which skills scaffold the development of metaphorical abilities. Metaphor comprehension is a complex process relying on multiple higher-order cognitive abilities with different developmental paths, such as alternative naming and analogical reasoning (Rubio-Fernández & Grassman, 2016). This study was aimed at (i) teasing apart the contribution of these two cognitive abilities necessary for metaphor understanding: *Alternative Naming* (i.e. accepting two labels for the same referent) and *Analogical Reasoning* (i.e. detecting similarities across objects); (ii) assessing their developmental trajectories within a single experimental paradigm which included a metaphor task; (iii) further characterizing metaphor developmental trajectory by identifying possible enhancing/impeding factors.

We tested 3- (N: 20; age range: 3;1–3;9; mean age: 3;4) and 4-year-olds (N: 20; age range: 4;1–4;11; mean age: 4;5) in three tasks: Metaphor Comprehension, Alternative Naming and Analogical Reasoning. The general procedure consisted of a picture-matching paradigm adapted from Morrisseau et al. (2013): the children were presented with several pictures arranged on a grid and were asked to move them according to the experimenter's instructions in order to match a given configuration. In the metaphor and alternative naming tasks, the experimenter asked the children to remove the pictures from the grid by referring to them either metaphorically or using an alternative label. In the analogy task, children were asked to choose the picture which best completed a given pattern and place it next to the other pictures of the sequence.

Metaphor Task: Eight triplets of pictures were shown to participants – each triplet corresponding to one trial. For each triplet/trial, the experimenter referred to the target picture either using a metaphor of the form [The X with the Y] or literally (e.g. ‘Give me the glass with the antennae/glass with the straws’ for a picture depicting a glass with two straws, see Fig 1a). There were four trials in each condition – metaphorical and literal. Children could choose one of three pictures: (i) *Target* (e.g. a glass with 2 straws); (ii) *Control I*, a literal competitor where both target and vehicle were literally shown (e.g. a glass and a girl wearing an antennae-headband); (iii) *Control II*, showing the metaphor target deprived of the relevant property (e.g. a glass with no straws).

Alternative Naming Task: Children saw 13 pictures on the grid that they had to reconfigure according to the experimenters' instructions. Eight were target pictures: four of them were referred to with the same term as they had been previously (ST condition) and four with a new term, (NT condition; e.g. ‘Give me the Lollipop/Candy’, see Fig. 1b).

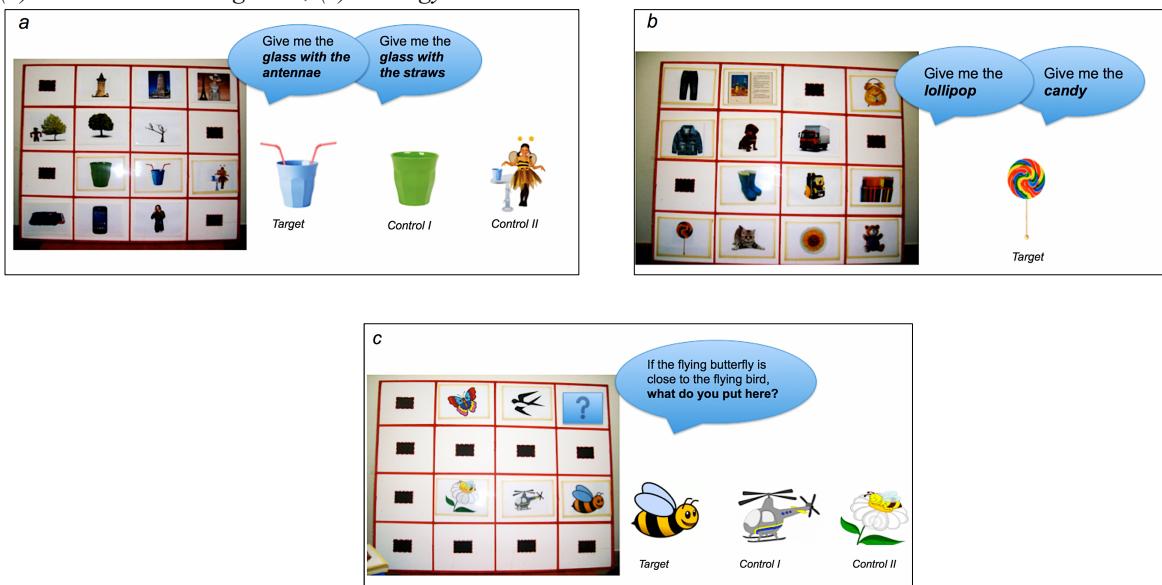
Analogy Task: In each of four trials, children had to choose the picture (out of three) which best completed a sequence of two pictures. The first two pictures of the sequence always shared a relational feature on which an analogy could be based (e.g. flying for the *animals that fly* analogy; see Fig. 1c). The three alternatives were: (i) *Target picture*, showing the relevant relational feature applied to the relevant object (e.g. a flying bee); (ii) *Control I*, showing the relevant property but on the irrelevant object (e.g. a helicopter); (iii) *Control II*, showing an irrelevant property but on the relevant object (e.g. a sleeping bee).

Vocabulary assessment: A picture naming-and-pointing game was administered to assess children's comprehension and production of the vocabulary used in the metaphor task.

Accuracy was coded for all tasks. Additionally, reaction times were collected for the metaphor and the alternative naming tasks. Data analysis was carried out separately for each task using Linear Mixed Models (LMM) statistics and Kendall's Tau correlations. Moreover, a Generalized Linear Mixed Models (GLMM) statistics was conducted to test if Alternative Naming and Analogy significantly predicted pre-schoolers' metaphor understanding. In the metaphor task, while all children exhibited more difficulties interpreting metaphorical than literal expressions ($p < 0.0001$), their accuracy improved with age ($p < 0.05$), with 4-year-olds only performing above chance. Both at ages 3 and 4 children performed well above chance in the Alternative Naming Task, with residual difficulties in 3-year-olds (NT vs. ST: $p < 0.001$) significantly lowered by four (NT vs. ST: $p = \text{n.s.}$). Both 3-and-4-year-olds performed at chance in the Analogy Task, with no significant difference between groups ($p = \text{n.s.}$). Importantly, the GLMM statistics indicated that both Alternative Naming and Analogy significantly predict pre-schoolers' understanding of metaphor. Specifically, the faster children were in the alternative naming task the more accurate they were in the metaphor task ($p < 0.0001$) and children with more developed analogical abilities showed a better performance in the metaphor task ($p < 0.0001$).

Our findings suggest that Alternative Naming and Analogy play a role in the development of metaphoric competence. By age 4, children's difficulties with alternative naming are fully solved and are likely not to increase the cognitive demands imposed by metaphor interpretation. It might nonetheless still be a minor source of difficulty for 3-year-olds. Analogical perception, on the other hand, may hinder the ability to understand metaphors in 3-year-olds and even, to a lesser extent, in 4-year-olds. Overall, the development of metaphoric competence is likely to depend from a cluster of cognitive abilities including alternative naming and analogical-reasoning skills. Each cognitive ability within this cluster might enhance or impede preschoolers' interpretation of a metaphor depending on its developmental trajectory.

Figure 1: Example of the material used in one trial for each of the experimental task: (a) Metaphor Task; (b) Alternative Naming Task; (c) Analogy Task.



References

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