Metacognitive processing in early childhood.

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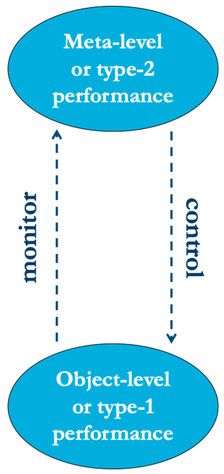
Theoretical background

-Metacognition refers to the ability of an individual to reflect on their own cognition and behaviour and it is mediated by an interaction between an object-level process (type-1) and a higher meta-level process (type-2) which monitors and controls it, in order to promote adaptive behaviour [1].

-Metacognition has been suggested to develop with age [2] and has been considered a fundamental ability for students' academic achievement in various domains [3].

-Research suggests that, during early childhood, a gradual shift from domain-specific to domain-general mechanisms supporting metacognitive processing occurs [4].

-However, up-to-date research in the development of metacognition is mainly based on self-report questionnaires and there is a lack of robust metrics of metacognition that can be comparable across tasks.



The present study

-We evaluated the metacognitive ability of a cohort of children aged between 6 and 7 (N=60) in three cognitive tasks (lexical decision task, visual attention span task, emotion recognition task) using confidence judgments in each trial.

-We used a hierarchical, free of bias, Bayesian framework [5] to estimate type-1 task performance (d' prime) and type-2 performance (metacognitive efficiency - meta-d'/d') in all tasks performed by the children, exploring the relationship between these parameters and a battery of standardized tasks testing for general cognitive abilities. We addressed the following research questions:

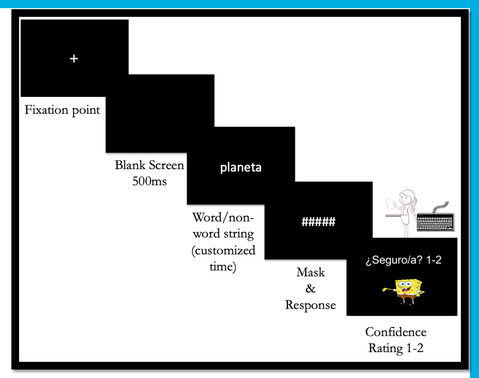


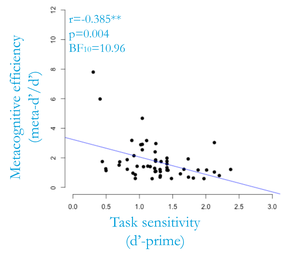
Figure 1- Example of task structure (Lexical Decision task)

1. **Does metacognitive ability of children correlate with their objective performance in the cognitive tasks?**
2. **Is metacognitive ability supported by the same mechanisms across the different tasks?**

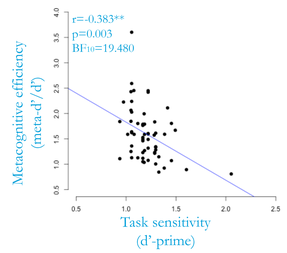
Main findings

(i) Type-1 performance across the three cognitive tasks negatively correlated with the level of metacognitive efficiency (HMeta-d/Hd) across participants.

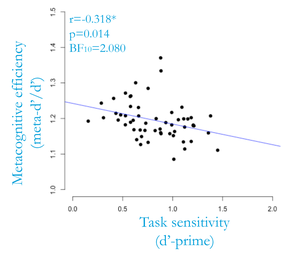
Lexical Decision



Emotion Recognition

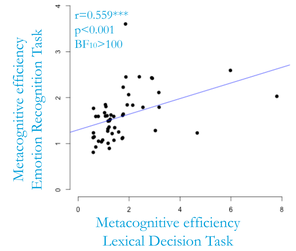


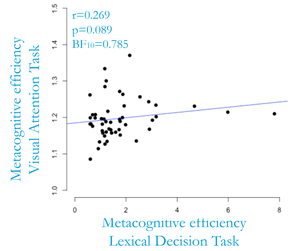
Visual Attention Span

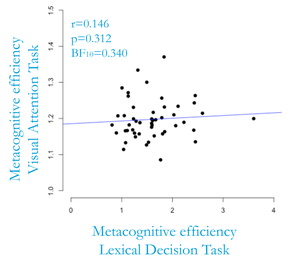


(ii) No evidence of associations between students' metacognitive efficiency on the three cognitive tasks and any of the standardized general ability tasks was found.

(iii) Metacognitive efficiency on the lexical decision positively correlated with the emotion recognition task, in keeping with a model of a domain-general metacognitive mechanism. This however was not borne out by the data from the visual attention span task.







Discussion

- Our results support that at this early age **students who perform worse in the tasks have better metacognitive efficiency**, contrary to healthy young adults who show positive correlation of metacognitive efficiency and type-1 performance. This could propose that students who struggle more in their first year of schooling, may be more prone to assimilate external feedback from teachers, which could assist them to acquire the complementary skills needed to improve their learning.

-Our study also suggests the **existence of a domain-general resource supporting metacognition** in lexical decision and emotion recognition task. The absence of association between metacognitive performance in the visual attention task and any other task could be due to differences in task structure, as lexical decision and emotion recognition task were identically structured using a 2-alternative-forced choice task, while visual attention task was a detection ('Yes/No') task [7].

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