Relationships between identifying relevant information and maths performance

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What we knew before…

The **embedded figures test (EFT)** measures ***an ability to separate a target from its context***.

This may involve **remembering** what the target is (triangle), **ignoring** the distracting overall picture (umbrella), and not being fooled by **distractor** shapes (shapes in the picture that are a bit similar to the target shape).

Research has shown that those who perform better on the EFT also perform better on academic tests, in maths for example.

Embedded figures test (EFT)

In the EFT you need to find a shape hidden in a picture (e.g. the triangle in the umbrella).

What we were trying to find out...

It is not clear why this relationship exists, and whether there are other things, like memory, that play a role. There were 2 main questions we wanted to try and answer:

1. **Is there a different relationship between the EFT and different types of maths questions?**
2. **Is there a relationship between performance on the EFT and eye movements during the task?**

What we did...

71 children from 4 different schools took part in the study. They completed 3 groups of activities:

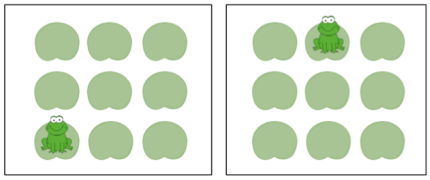
Maths questions:
- Number questions (arithmetic, fractions, and rounding)
- Word problems (same skills as the number questions)
- Geometry questions (shape, angles, and position)
- Statistics questions (graphs and tables)

General abilities (known as executive functions):
- Verbal working memory **(A)**
  (repeating a sequence of letters backwards)
- Visuo-spatial working memory **(B)**
  (repeating the jumps of a frog backwards)
- Semantic inhibitory control **(C)**
  (choosing the biggest animal in 'real life' out of a pair of animal pictures, ignoring the size of the picture)
- Response inhibitory control **(D)**
  (clicking on the mole as fast as possible, but not the aubergine)

(A)

r q b x k

(B)



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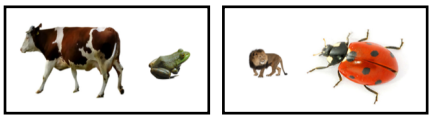

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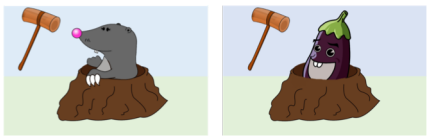


(E)

Eye tracking:
- The EFT was completed in the eye tracking tent **(E)**.
- The eye tracker measured where children were looking during the task.

Why eye tracking?

There is too much information around us at any one time for us to take in and understand. Attentional skills are used to focus on some of this information. Eye tracking is a way of measuring where our **visual attention** is focusing and gives us a good idea of what information is being collected by our eyes.

What we found...

Q1: Is there a different relationship between the EFT and different types of maths questions?

I predicted ...

We thought that children who achieved a higher score on the EFT would also score more highly on the maths questions.

I found ...

There was a positive relationship between EFT scores and overall maths scores. This matched what we were expecting, but the relationship was weaker than we had seen in other studies. When we included general ability scores, verbal working memory was more important than EFT for predicting maths performance.

I predicted ...

We thought word problems would have a closer relationship with EFT than number problems, and that geometry would also have a close relationship with the EFT.

I found ...

The evidence wasn't strong enough to say that the EFT had a closer relationship with word problem performance than number performance. This is different from some previous research and not what we predicted.

There was a positive relationship between EFT and geometry scores which is what we expected to see. Even after taking account the other maths scores and the general ability scores, the EFT still predicted performance on the geometry questions.

Q2: Is there a relationship between performance on the EFT and eye movements during the task?

I predicted ...

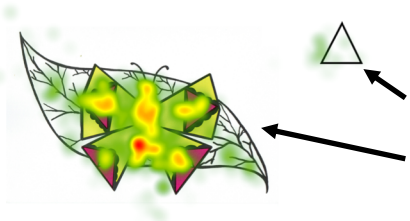
We thought that children who had higher scores on the EFT would look less frequently at the target shape (as they would remember it better) and would look less at distractor shapes (as they would be better at ignoring distractors).

I found ...

Children who had better **visuo-spatial working memory** or who were better at ignoring the distractor aubergines in the **response inhibition task**, achieved **higher** scores on the EFT. This is what we expected as both memory and ignoring distractors play a role in the EFT.

However, it seems that those with poorer working memory did not use the target shape to refresh their memory any more often than the rest of the group. This is not what we predicted.

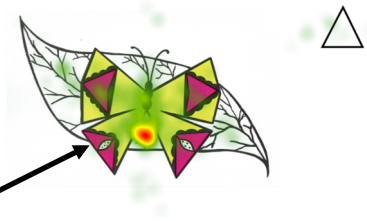
Those with higher scores on the **response inhibitory control** task spent more time looking at the hidden shape, while those who more quickly overcame distractions on the **semantic inhibitory control** task spent less time looking at the distractor triangles. This shows that there are different inhibitory control processes involved with overcoming distractions and keeping attention on the relevant information.



*Looking patterns of children who scored **lower** on the EFT*

Here, the group who scored lower on the EFT looked to the target triangle more often, and looked at the distractor triangles (on the butterfly wings) more often. The group who scored higher focussed more on just the hidden shape.

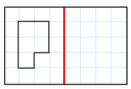
Key: Looking time
Shorter  Longer



*Looking patterns of children who scored **higher** on the EFT*

What this means...

Although there was a relationship between EFT and overall maths scores, this was strongest for the geometry questions. This may be because both tasks require a focus on shape **features** without being distracted by what's around it. For example, to identify acute angles, you need to focus on the corners and ignore the rest of the shape, and to draw something in a mirror line you need to focus on one part of the shape at a time.



We also now have a better understanding of how children tackle the EFT, and how general abilities play a role in the task. Although we don't know if these patterns are the same for other visual tasks, it is a useful reminder that distracting information can have an impact on performance.