Investigating the relationship between executive functions, numeracy and non-verbal reasoning skills in adolescence.

Citation for published version:

Link:
Link to publication record in Edinburgh Research Explorer

Document Version:
Peer reviewed version

General rights
Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy
The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.
Investigating the relationship between executive functions, numeracy and non-verbal reasoning skills in adolescence.

Thalia E. Theodoraki¹, Sarah McGeown², Sarah E. MacPherson¹

¹ School of Philosophy, Psychology and Language Sciences, University of Edinburgh
² The Moray House School of Education, University of Edinburgh

**Background**

Executive functions (EF) are a collection of mental control processes that direct cognitive activity. They have repeatedly been found to be associated with academic attainment. (Latzman, Elkovitch, Young, & Clark, 2010; St Clair-Thompson & Gathercole, 2006)

In recent years, transferable skills have been accentuated as precursors of pupils’ academic attainment.

In order to further understand the association between EFs and academic attainment it may be wise to break it down into simpler components. Therefore, this study looks into the relationship between EFs and two core skills that underpin academic success.

**Methods**

Three EF components (Miyake et al., 2000) were assessed during individual sessions with pupils:
- Inhibition: D-KEFS Color-Word Interference task
- Shifting ability: D-KEFS Sorting task (first condition)
- Updating of working memory: BAS-II Recall of Digits: Backward task

Two core skills were measured using pen and paper assessments:
- Numeracy: BAS-II Number skills
- Non-verbal reasoning: BAS-II Matrices

Multiple linear regression analysis was used to develop models (p2) predicting pupils’ numeracy and non-verbal reasoning skills from their scores on EF tasks.

**Results**

All EF components were significantly related to one another. Shifting and Updating were significantly correlated with numeracy skills. Shifting and Inhibition were significantly correlated with non-verbal reasoning skills.

Numeracy skills were best predicted by a model including performance on all three EF tasks (Figure 2a).

Non-verbal reasoning skills were best predicted by a model including performance on the Inhibition and Shifting tasks (Figure 2b).

<table>
<thead>
<tr>
<th>a) Numeracy</th>
<th>b) Non-verbal reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>Step 2</strong></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.117</td>
</tr>
<tr>
<td>Inhibition</td>
<td>0.138</td>
</tr>
<tr>
<td>Alpha</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Inhibition</td>
<td>0.138</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.117</td>
</tr>
<tr>
<td>Inhibition</td>
<td>0.138</td>
</tr>
<tr>
<td>Alpha</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**Conclusions and further plans**

Although all the EF components were found to be significantly related to one another, the largest association was that between Updating and Inhibition.

Both the correlational analysis and the regression models suggest there is a relationship between EFs and the core skills of numeracy and non-verbal reasoning.

This study presents the preliminary results of a wider ongoing project, with a total sample of ~400 pupils aged 13-17 and measures of academic attainment (National exams grades) as well as transferable skills, which aims to decipher the relationship between EFs and academic attainment.

**References**


**Acknowledgements**

A special thank you to the schools that supported the project and to each pupil that participated.