Executive function in people with early-stage dementia: an exploration of commonly used tests

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Introduction

- Alzheimer's disease (AD), at least in the early stages, is typically characterised by impairments in memory; however, for a diagnosis of Alzheimer's disease to be made, other deficits also have to be present.
- One area of cognition that may be affected is executive functioning (EF), an umbrella term for a number of distinct high-level cognitive processes that control everyday actions and thoughts (Elliott, 2003; Royall et al., 2002).
- There is evidence that a proportion of people with early dementia display impairments in EF.
- Swanberg et al. (2004) found that 64% of people with AD displayed evidence of executive dysfunction in at least one of two EF tests: letter cancellation and Mazes; n = 131.
- We recently reported, using stricter cut-off criterion than Swanberg et al., that 20% of people with AD, vascular dementia (VaD) and mixed AD and VaD displayed impairments in letter fluency (Martyr et al., 2012); n = 96.
- Previous research has tended to use a limited range of EF tests, this study will employ a wide range of EF tests to explore which aspects of EF are most likely to be impaired in people with early stage dementia.

Method

- Thirty-six people with mild to moderate AD, VaD, or mixed dementia completed 11 tests of EF yielding 32 indices of EF; see Table 1 for sample characteristics.
- To be included participants had to have a dementia diagnosis and an MMSE score of 18 or above.

Table 1

<table>
<thead>
<tr>
<th>N</th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>15</td>
<td>79.14 (7.67)</td>
</tr>
<tr>
<td>Male</td>
<td>21</td>
<td>13.29 (3.43)</td>
</tr>
<tr>
<td>Alzheimer’s</td>
<td>32</td>
<td>22.89 (2.83)</td>
</tr>
<tr>
<td>Vascular</td>
<td>1</td>
<td>65.72 (10.47)</td>
</tr>
<tr>
<td>Mixed</td>
<td>3</td>
<td>103.97 (12.06)</td>
</tr>
</tbody>
</table>

Tests of Switching:
- Trail Making Test (TMT) Part 4 (TMT-B), Verbal Fluency (VF) Switching Accuracy, Stroop Switching, Design Fluency (DF) Switching.

Tests of Initiation:
- 20 Questions Achievement score.
- 20 Questions number of questions asked.
- 20 Questions Abstraction score.

Tests of Planning:
- BADS Zoo Map, BADS Key Search, Tower Rule Violation, Tower Achievement score, Tower First Move Time, Tower Move Accuracy.

Tests of Visual Perception:
- TEA Map Search.

Tests of Inhibition:
- Hayling 2 Errors, Hayling Part 2, Classic Stroop.
- Category Fluency.
- Letter Fluency.
- BADS Rule Shift.

Tests of Processing Speed/Abstract Thinking:
- Tower Total Time.
- TMT Letters, Stroop Colour Recognition, Stroop Colour Word Reading.
- TMT Numbers (TMT-A), Tower Move Accuracy.
- BADS Temporal Judgement.

Results

On average, individual participants had impaired scores on 14.5 (SD 6.07) of the 32 indices of EF.

As shown in Figure 1, D-KEFS Trail Making Test Part 4, D-KEFS Verbal Fluency Switching Accuracy, D-KEFS Design Fluency Switching, D-KEFS Stroop, D-KEFS Stroop Switching, Hayling errors, BADS Zoo Map Test and the time taken to complete the D-KEFS Tower Test had the highest percentages of people obtaining scores in the impaired range.

Conversely, D-KEFS Letter Fluency, D-KEFS Tower Test accuracy, D-KEFS 20 Questions, BADS Rule Shift, BADS Temporal Judgement and time taken to complete both parts of the Hayling Test showed the least evidence of impairment.

Discussion

- The study investigated impairments in a wide range of executive function tests in people with early dementia.
- The study supported previous research (Martyr et al., 2012; Swanberg et al., 2006) in which a proportion of people with early dementia showed evidence of impaired executive function.
- In particular the switching aspect of EF showed consistent evidence of impairment with over 50% of the sample being impaired in each test.
- Tests of inhibition, initiation and planning tended to show less evidence of impairment, with the Stroop test, errors made on the Hayling Test Part 2 for inhibition and the BADS Zoo Map Test for planning being notable exceptions.
- Tests where time was an important component were consistently found to show impairments in EF.

Conclusions

- The findings suggest that switching ability, specific tests of inhibition and planning as well as processing speed tend to be impaired early in the course of dementia.
- Therefore, tests of switching may be useful in diagnosing dementia though they may be less useful to monitor longitudinal EF decline in dementia.
- Further research is required to investigate whether the tests of EF where there was little evidence of impairment in the early stages of dementia will be useful to monitor EF decline over time.

References