Individual differences in auditory and visual working memory

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Introduction

Previously, fMRI scans revealed differences between individuals in the size and connectivity of frontal visual and auditory structures (1, 2, 3).

Long-term goal: Study whether those structural differences translate into differences in cognitive abilities.

This project: 1. Curate a task to measure auditory and visual working memory (WM) capacity; assess task for reliability.

2. Test whether subjects’ self-assessed background and/or preferences in visual and auditory cognition relate to measured WM capacity.

Methods

For the main trials, we presented four visual or auditory stimuli as the memory set. After a brief retention interval, a probe was presented and subjects decided whether the probe was ‘old’ or ‘new’.

To minimize effects of familiarity, subjects completed a pre-exposure task with simple questions about the stimuli (e.g. Is this animal a predator or prey?).

To test for reliability, subjects completed the same task twice, about two weeks apart.

Additionally, they filled out questionnaires assessing their involvement in music, art, and spatial awareness. Questionnaires included the Multiple Intelligences Developmental Assessment Scales (MIDAS) test along with visual and musical versions of the Goldsmith Musical Sophistication Index (Gold-MSI). The Gold-MSI test divided into two scales: Active Engagement (AE) and Training (T).

All questionnaire results were compared with subject performance to ascertain if backgrounds could predict WM capacity.

Visual WM measurements have high test-retest reliability

Visual task performance was fairly consistent, with 72% of participants differing by 0.5 items or less in the second session. The auditory test had only 50%.

Dissimilarity in consistency may be due to differences in training or level of task difficulty (people typically performed worse/had longer reaction times for the auditory task). In addition, session two auditory scores were mostly higher, sometimes much higher, implying subjects were still learning the test.

Questionnaires appear valid as self-assessments

The training (T) sections of the Gold-MSI for visual arts and music were moderately to strongly correlated with the MIDAS spatial and musical sections (r = 0.60, 0.82 respectively), while the active engagement (AE) sections were moderately correlated (r = 0.53, 0.69) supporting their validity as self-assessments.

Subject background doesn’t strongly predict performance

Questionnaire results varied widely in terms of correlation with task performance. Formal training weakly predicted visual performance in both sessions (r = 0.22, 0.25), but only auditory performance in session one. The highest correlation occurred between the MIDAS musical section and session one of the auditory task, at r = 0.33.

Next Steps

Modify auditory stimuli to make them more discriminable, making the task more accessible to increase test-retest consistency.

Continue gathering data to more accurately estimate relationships between questionnaire scores and WM capacity.

Seek out subjects with unusually high visual or auditory memory capacity scores and recruit them for future fMRI studies of brain function.

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