Novel fMRI-derived Auditory Attention-for-Response Network

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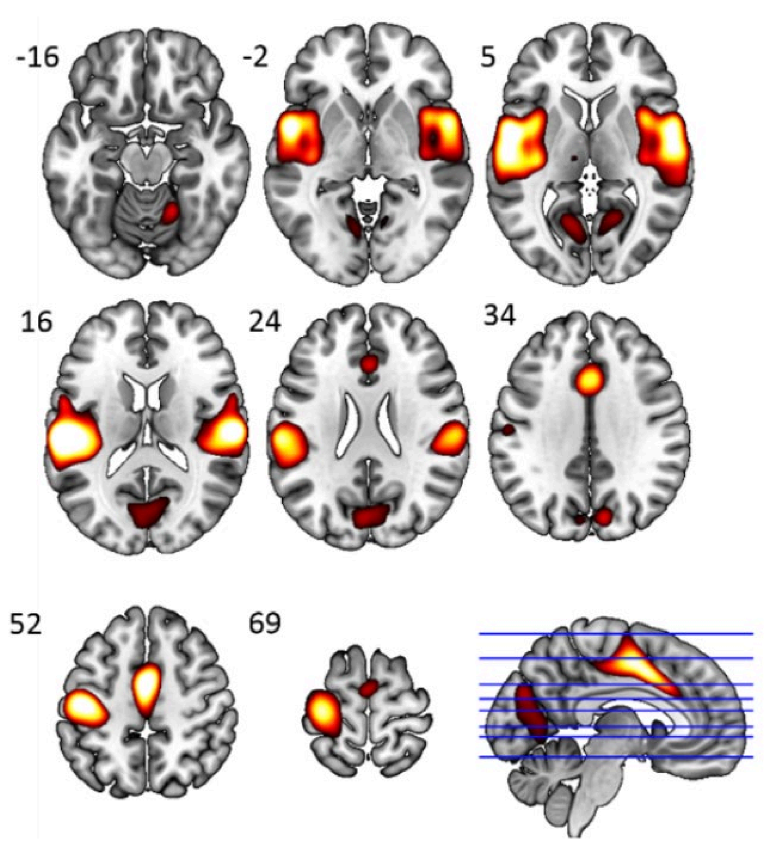
Introduction

Twelve task-based functional brain networks have previously been identified [4]. This study aims to characterize the function of the Auditory Attention-for-Response (AAR) network.

Recruitment of the AAR network is classified by activation in the bilateral superior temporal gyrus, supplementary motor area, left precentral gyrus, bilateral insula, and thalamus [2].



Methods

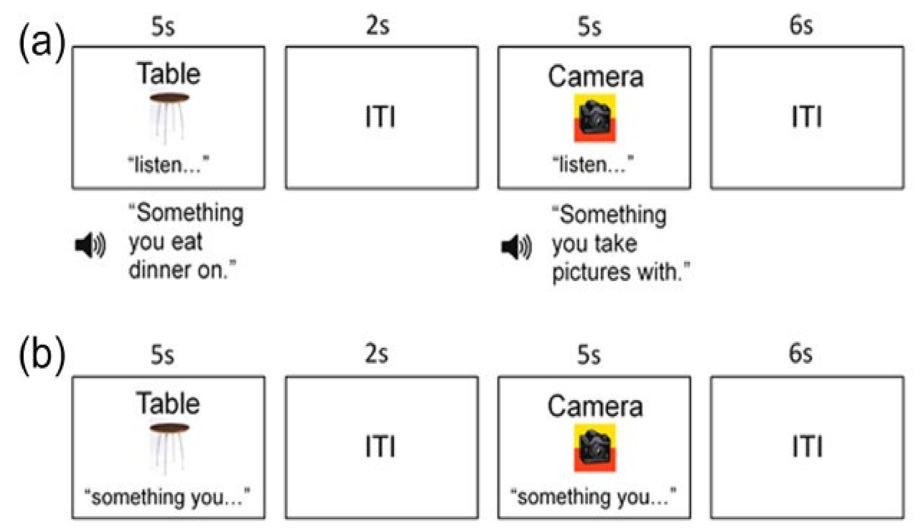
fMRI constrained principal component analysis (CPCA) was used to identify AAR in different functional tasks.

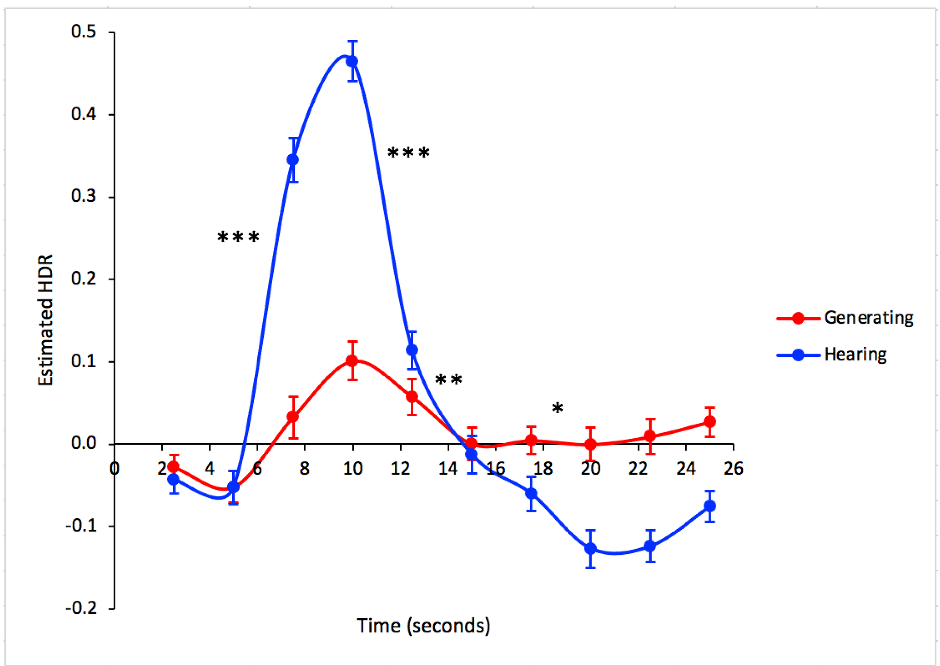
fMRI-CPCA produced predictor weights for each combination of condition, group, and post-stimulus timebin, which were then used to create hemodynamic response (HDR) curves to show reliability of activation and suppression of the network.

Mixed ANOVA was performed using predictor weights to analyze significant effects of group and/or condition in 11 distinct tasks that recruited AAR, and a comprehensive conclusion was drawn based on results. 4 tasks are shown here.

Results

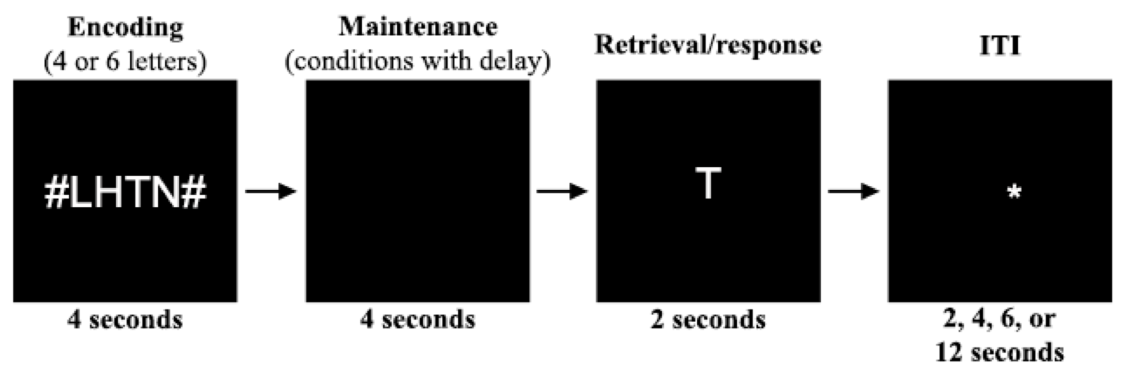
Thought Generating Task [1,3]

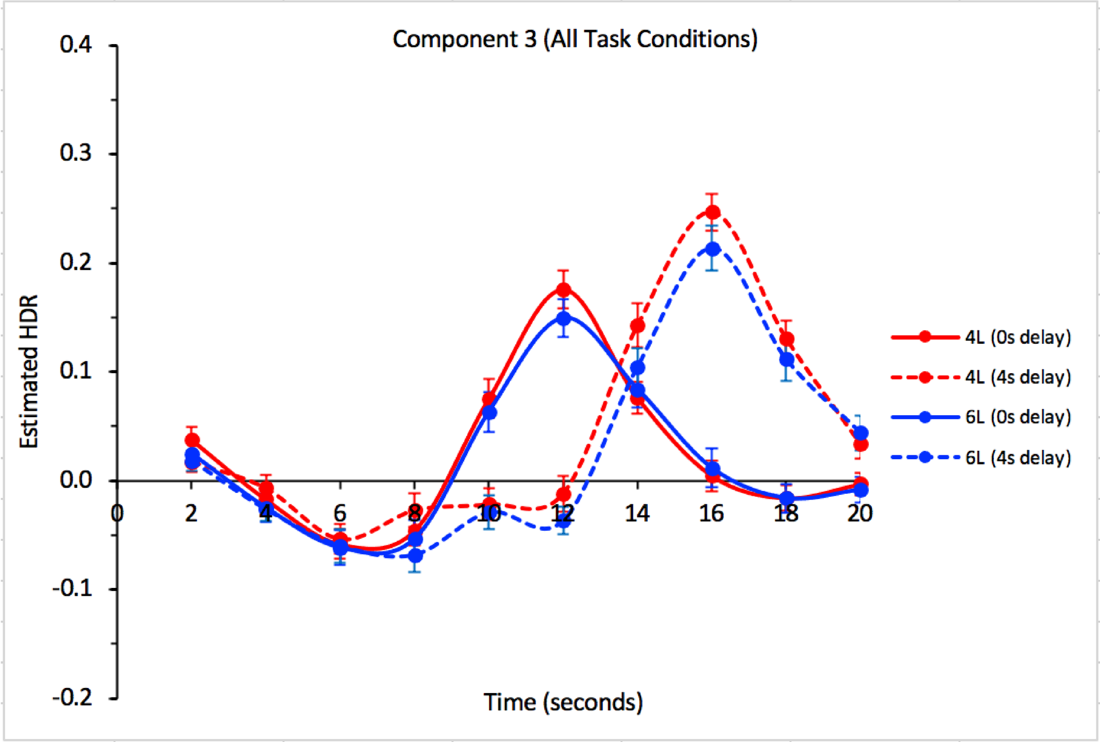




Significant main effects of
•Time, $F(9, 522) = 58.533$, $p < 0.001$
•Task Condition, $F(1, 58) = 45.638$, $p < 0.001$
Significant interaction between
•Task Condition × Time, $F(9, 522) = 34.763$, $p < 0.001$

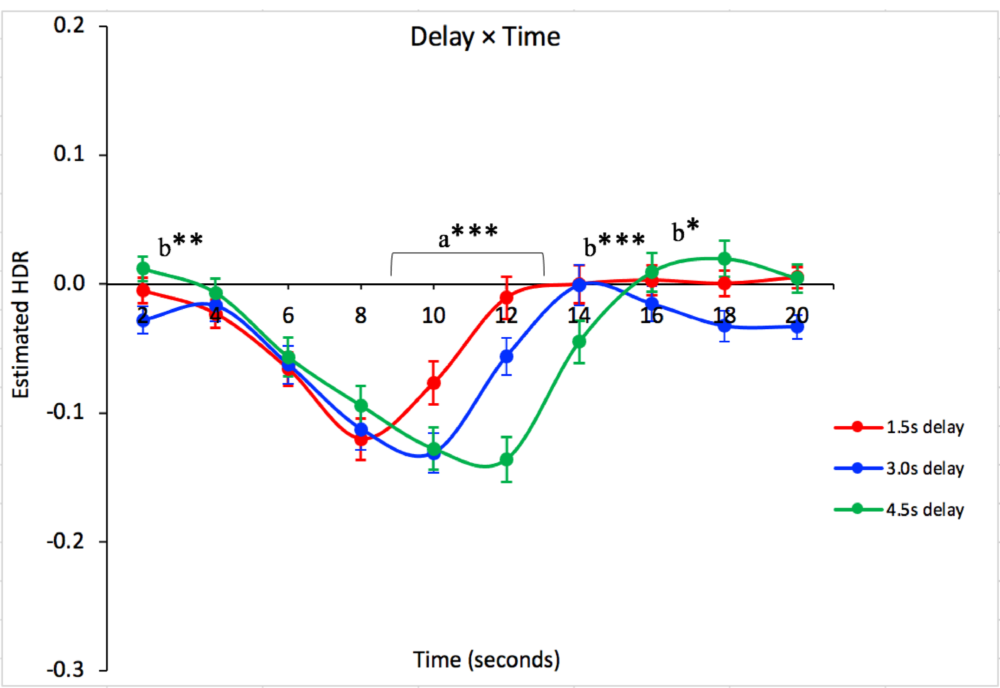
Working Memory Task [3]

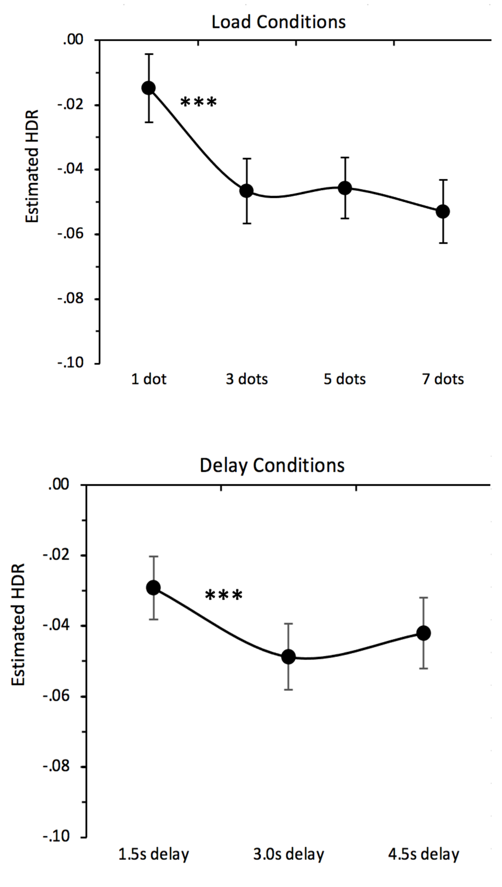


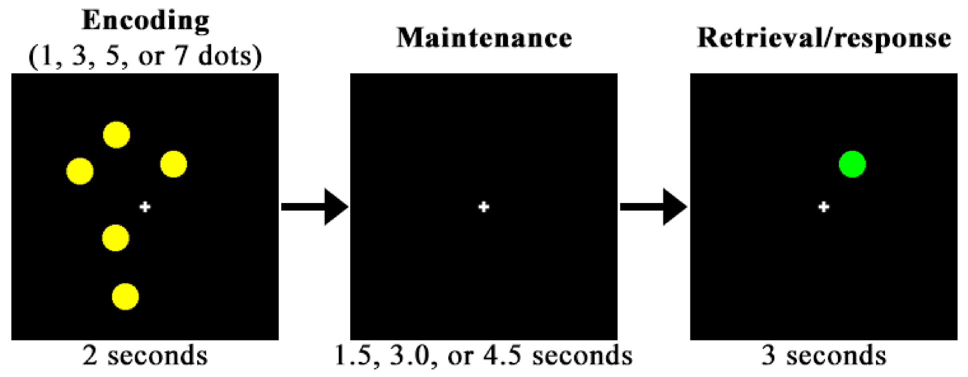


Significant main effects of
•Load, $F(1, 52) = 4.011$, $p = 0.050$
•Delay, $F(1, 52) = 8.836$, $p < 0.01$
•Time, $F(9, 468) = 42.390$, $p < 0.001$
Significant interaction between
•Delay × Time, $F(9, 468) = 66.551$, $p < 0.001$
•Delay × Time × Group, $F(9, 468) = 2.993$, $p < 0.05$

Spatial Capacity Task [3]

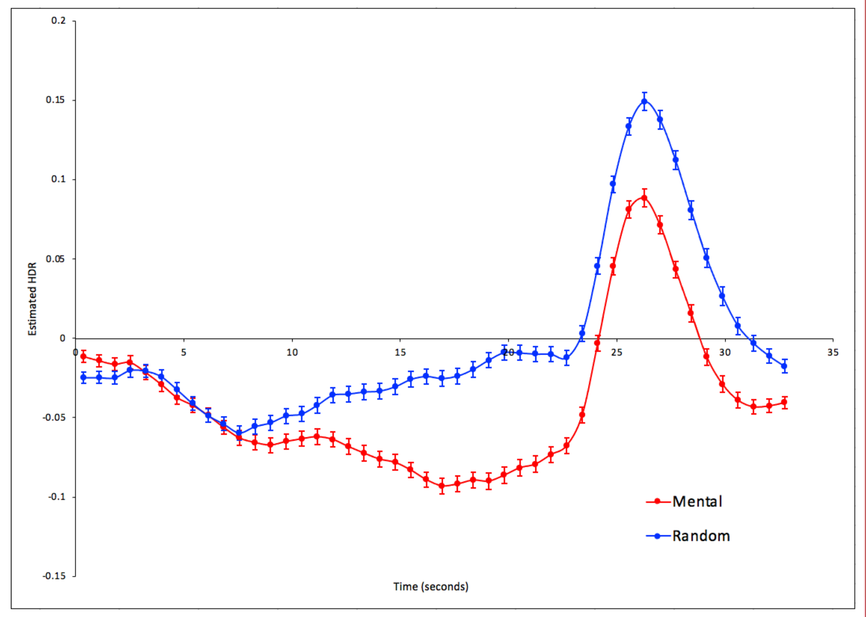


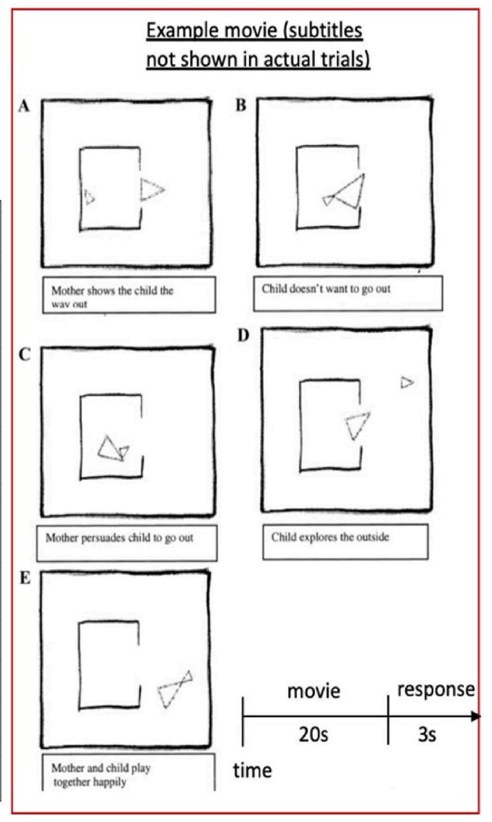




Significant main effects of
•Load, $F(3, 258) = 12.159$, $p < 0.001$
•Delay, $F(2, 172) = 8.203$, $p < 0.001$
•Time, $F(9, 774) = 27.779$, $p < 0.001$
Significant interactions between
•Load × Delay, $F(6, 516) = 3.496$, $p < 0.01$
•Load × Time, $F(27, 2322) = 5.167$, $p < 0.001$
•Delay × Time, $F(18, 1548) = 12.217$, $p < 0.001$
•Load × Delay × Time, $F(54, 4644) = 2.408$, $p < 0.001$

Social Task





Significant main effects of
•Time, $F(45, 22455) = 261.973$, $p < 0.001$
•Condition, $F(1, 499) = 348.720$, $p < 0.001$.
Significant interaction between
•Condition × Timebin, $F(45, 22455) = 41.124$, $p < 0.001$

Conclusion

•Three main factors that correlate with AAR activity include presence of auditory stimuli, motor response and planning for response, and level of visual attention required
•AAR network reveals inverse relationship between auditory and visual stimuli. As cognitive demand for visual attention increases, AAR activity decreases; there is greater deactivation associated with greater cognitive load and interpretation of complex social interactions
•AAR activity increases as the allocated attention to motor response increases, as exhibited through duration of maintenance period

References

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