Using fNIRS to Probe the Effects of Response THE UNIVERSITY of THEUNIVERSITY **Type in a Visual Working Memory Task KNOXVILLE** KNOXVILLE Rachel N. Eddings and Aaron T. Buss

Introduction

Visual working memory (VWM) allows us to hold visual information in mind to be manipulated for a task. Previous research shows that performance varies based on factors such as stimulus modality and number of distractors. This study aimed to explore the effects of response type on VWM performance in 4.5- and 5.5-year-olds. A single-item probe color change detection and a cued recall with labeling task were administered. Neural data were collected using functional near-infrared spectroscopy. Both tasks used set-sizes 1-3 and six canonical colors (red, orange, yellow, green, blue, purple). All children were given the tasks in a fixed order, with the change detection task first. Behavioral analyses show that children's performance declined as set-size increased in both tasks (F(2,11)=65.438, p<0.001). This effect was more pronounced in cued recall than in change detection (F(2,11)=7.769, p=0.003). Moreover, VWM capacity was estimated to be higher in the change detection task (k=2.53) compared to the cued recall task (k=1.24) (p<0.001). When we look at the neural data, both tasks activated bilateral temporal and parietal cortices. The change detection task also elicited activation in bilateral frontal cortex. Though both tasks required the same working memory processes, distinct neural regions were involved based on the response type. Lastly, increases in activation over set-size, a key signature of VWM, was only observed in the change detection task, suggesting that this pattern of activation may be an artifact of response type rather than an actual signature of working memory. Tasks and Stimuli Change Detection Cued Recall Location Clust Left Inferior 80 Parietal Lobule 5.5 y.o. Right Superior 4.5 y.o. > Parietal Lobule 5.5 y.o. $\boldsymbol{\times}$ Match Condition Right Inferior 5.5 y.o. > **No-Match Condition** Frontal Gyrus 4.5 y.o. X Task Progression O Right SupraMarginal 5.5 y.o. Memory Memory Gyrus Array Array **Clust** Location Blank Blank 1.5 s 1.5 s Right Superior CR > CD card card Task Parietal Lobule Right Rolandic Deact. Memory Test Cue Array Operculum $\boldsymbol{\times}$ Left Inferior Parietal Lobule Ň O fNIRS Data Collection and Analyses Right Middle Temporal Gyrus Probe designed to record from network Emitter detector distance $(3 \sim 4 \text{ cm})$ Detector involved in VWM, measuring from bilateral **Clust** Location Grey matter Data frontal, temporal, and parietal regions - The path of detected light COllected Right Superior SS3 > SS1 Parietal Lobule & 2 using S S TechEn Left Inferior CW7 (690 Parietal Lobule Deact. SS2 $\boldsymbol{\times}$ and 830 Left Postcentral SS3 > SS2 nm) C Gyrus **Right Middle** Temporal Gyrus Deact. SS1 Final statistical analyses conducted using Volumes constructed by AFNI functions 3dMVM (3dClustSim used for subject head volume + FWE correction, < .05) Colin's atlas = brain surface Standard pre-processing in EasyNIRS: model Convert to optical density Activation values Wavelet motion filtering (iqr=0.5) projected into Conversion to concentration values memory. volumes. using modified Beer-Lambert Group mask created equations (dpf=ppf=6.0) using voxels in which • Average HbO and HbR calculated all subjects within 4-6s time window for each Near-Infrared Spectroscopy." NeuroImage 85 (2014): 314–25. task





University of Tennessee, Knoxville

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Results



Conclusions

So far, we are seeing age effects in both behavioral and neural data suggesting that there is a developmental shift occurring during this time period. • Need to look further into age effects, specifically between tasks to see if the response difference is affecting performance and neural signatures. Set-size effect was only observed for Change Detection. The set-size effect might be an artifact of response type rather than an actual signature of working

Data collection is on-going and the full data set is needed for complete analyses in order to examine associations between performance and activation.

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