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57 Sensitivity of functional Near-Infrared Spectroscopy in Individuals with Posterior Cortical Atrophy

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Objective: Functional near infrared spectroscopy (fNIRS) is a form of non-invasive neuroimaging that uses light to measure changes in oxygenated and deoxygenated hemoglobin (Yucel et. al., 2021). Relative to fMRI, fNIRS is significantly cheaper and less susceptible to motion artifacts thereby enabling researchers to acquire data in more ecologically valid environments and has a higher temporal resolution that makes it well-suited for connectivity analyses (Tak and Ye, 2014). fNIRS is, however, uniquely limited by cortical anatomy. With a typical probe array having a penetrance depth of up to 3cm, the benefits of fNIRS may be limited by the neocortical atrophy that is characteristic in those with neurodegeneration. We present preliminary findings comparing fNIRS probe sensitivity in older adults diagnosed with posterior cortical atrophy (PCA) relative to cognitively intact older adults using Monte Carlo (MC) simulations. MC simulations offer probabilistic models that simulate photon movement through tissues of interest. We were particularly interested in fNIRS' sensitivity in the occipitoparietal cortices since these are regions characteristically affected in PCA.
Participants and Methods: We acquired high resolution structural (T1) MRI on 3 cognitively intact older adults and 3 individuals who received a clinical diagnosis of PCA according to Crutch et al. (2017) criteria. Individual T1 scans were preprocessed and transformed into a two-dimensional (2D) surface using FreeSurfer. This continuous 2D surface was then segmented into its main tissue priors, as well as its pial surfaces. Segmented MRIs were then imported into AtlasViewer software and registered to our full head fNIRS probe array via an affine transformation. We embedded the GPU-accelerated Monte Carlo Extreme 3D light transport simulator software (Fang and Boas, 2009) into AtlasViewer which enabled us to launch 10 million photons from each optode, compared to the 1 million that AtlasViewer is set to by default, thereby providing more accurate results (Aasted et. al., 2015). We then assessed the sensitivity profile (log units), a mathematical estimate of optical density, of the inferior and superior occipital gyri, middle occipital gyrus, the superior and inferior parietal lobules, and left and right precunei.
Results: Among the regions interrogated, five channels on our fNIRS probe were markedly different between the controls and those with PCA. Specifically, sensitivity values for channels covering the right inferior (hedges g = 8.04) and left superior occipital gyrus (hedges g = 2.46), the right inferior parietal lobule (hedges g = 8.89), and the right (hedges g = 9.43) and left (hedges g = 14.83) precunei were all markedly lower in those with PCA.
Conclusions: We provided preliminary evidence that the sensitivity of fNIRS appears to be markedly reduced in those with PCA. This is especially relevant for researchers using fNIRS in populations with neurodegeneration. Future work will evaluate these findings in a larger sample as well as in other neurologic conditions with the goal of helping researchers appropriately power their studies and interpret their results.

Categories: Neuroimaging
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58 Hippocampal Subregions Predict Executive Function Across the Adult Lifespan

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