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Baker, Joseph M.; Martin, Taylor; Aghababyan, Ani; Armaghanyan, Armen; Gillam, Ronald

Cortical activations during a computer-based fraction learning game: preliminary results from a pilot study.

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Summary: Advances in educational neuroscience have made it possible for researchers to conduct studies that observe concurrent behavioral (i.e., task performance) and neural (i.e., brain activation) responses to naturalistic educational activities. Such studies are important because they help educators, clinicians, and researchers to better understand the etiology of both typical and atypical math processing. Because of its ease of use and robust tolerance of movement, functional near-infrared spectroscopy (fNIRS) provides a brain-imaging platform that is optimally suited for such studies. To that end, the focus of the current research is to use fNIRS to help better understand the neural signatures associated with real-world math learning activities. For example, the computer game "Refraction" was designed as a fun and engaging method to improve fraction knowledge in children. Data collected in previous studies have identified significant correlations between Refraction play and improvements in fraction knowledge. Here we provide the results of a pilot study that describes participants' cortical activations in response to Refraction play. As hypothesized, Refraction play resulted in increases in parietal cortical activations at levels above those measured during spatial-specific activities. Moreover, our results were similar to another fNIRS study by *T. Dresler* et al. ["Arithmetic tasks in different formats and their influence on behavior and brain oxygenation as assessed with near-infrared spectroscopy (NIRS): a study involving primary and secondary school children", J. Neural Transm. 116, No. 12, 1689–1700 (2009; `doi:10.1007/s00702-009-0307-9`)], where children read Arabic numeral addition equations compared to written equations. Our results provide a valuable proof-of-concept for the use of Refraction within a large-scale fNIRS-based longitudinal study of fraction learning.