An Immersive 3D Brain Simulation that Future Health Professionals Explore via the Oculus Rift™ Virtual Reality Headset

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Problem Statement: Students of medicine and neuroanatomy attempt to create an internalized 3D map of brain structures and their connections. Unfortunately, understanding the complex structures and pathways of the brain in 3D is difficult. Text-based descriptions combined with 2D teaching tools such as diagrams, videos, and radiological slices cannot deliver a complete mental model of the pathophysiology of brain-based disorders. The disparity, unique to the brain vs. simpler organs such as the kidney, liver and heart, potentially explains the limited assessment and treatment efforts afforded to the importance of the brain in obesity as well as more obvious brain-based disorders such as dementia, addiction and mental health disorders.

Approach: The rich data and visualizations created via the NIH BRAIN Initiative and the component Human Connectome Project offer a potential aid to students. Tractographic analysis of the data obtained via MRI Diffusion tensor imaging (DTI), diffusion functional MRI (DMRI) and diffusion spectrum imaging (DSI) may help students visualize neuronal pathways. Using tractography data from DTI we will build a 3D model of the brain that learners will experience in an immersive 3D virtual environment using Unity 3D and the Oculus Rift™ VR platform. Oculus enables a near perfect representation of reality in terms of low lag and a full field of view. It evokes strong engagement; users perceive themselves inside a real-world 3D environment.

The complex biological basis of obesity medicine is taught via a Unity 3D-based "breakout" learning experience to provide a basic science foundation for the clinical knowledge.

Short Description: With NIH/NIDDK funding (SBIR Grant #1 R44 DK108608-01, Serious Game-based Development of Obesity Intervention Skills) we are creating educational tools to enhance student understanding of obesity and the CNS structures and communication involved in weight control. A planned study compares an immersive Oculus 3D experience with a 2D version of the same content to assess impact on: neuroanatomical knowledge, confidence in the ability to acquire more knowledge, and interest in learning more about the biological cause of obesity. We will also measure attitudes related to: the scientific basis of obesity. Process outcomes include measures of realism, simulation sickness side effects, and satisfaction.

Progress: Initial work is focusing on describing the user experience, overcoming technological hurdles associated with Oculus, assessing and decreasing risk of simulation sickness, and investigating a methodology to convert tractographic data to a Unity-based 3D virtual environment. To assess the need for 3D visualization, we surveyed 36 students in the health professions. We also asked them to rate the value of various tools to visualize brain neuroanatomy including 2D diagrams, dissections, radiological scans, textual descriptions, 3D visualizations [represented on a 2D screen], glossaries and slides.

Lessons Learned: The survey revealed that 72% felt that Interactive/Exploratory 3D Representations would be extremely useful vs. 33% for static 3D representation. "Extremely Useful" ratings were also much lower for cadavers (47%), diagrams (47%), video (42%) and radiological views (31%). Only 17% of respondents agreed or strongly agreed that existing tools were adequate to learn about 3D bodily structures; 47% disagreed that existing tools were adequate. Eighty percent (80%) of respondents agreed or strongly agreed that "I wish there were better tools to understand 3D structures."

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References


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