Age-related Cognitive Decline and Enriched Environments Examining Real-time Psycho-spatial Dynamics Using Virtual Reality

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1. EXTENDED ABSTRACT

Human life is embedded in physical space, which is increasingly a built environment. Environment can challenge human performance when insufficient lighting or obstacles increase risk of falls in older adults. Conversely, environment can empower people, fostering creativity and well-being by extending people's cognitive and physical abilities (Malinin, 2016). Bi-directional space-individual interaction, therefore, involves integration of physical, cognitive, and emotional cue by the nervous system. Our interdisciplinary research examines relationships between spatial designs and cognitive and brain health in aging.

Maintaining and enhancing cognitive performance in the face of age-related declines is one of the top priorities in our aging society. Demographic studies show adults leading active lifestyles, through exercise or unstructured activities like gardening, dancing, or walking, score higher on cognitive tests than sedentary peers (Blazer et al., 2015; Bherer et al., 2015, Hertzog et al., 2008). Physically active older adults have 'younger' looking brains; those who engage more often in higher intensity physical activity have less age-related lesions in their white matter and adults who spend less time sitting have greater integrity of white matter near the hippocampus (Burzynska et al., 2014). Research also suggests physical activity and exercise improve brain health even when started later in life (Burzynska et al., 2015). We consider how environments for aging may be enriched to promote user physical and cognitive activity through novelty, challenge, and engagement.

We examine impacts of three environmental conditions (low-sensory, high-sensory, and interactive-stimulating) on arousal, activity, and memory. Virtual reality (VR), our chosen testing environment, provides high experimental control and ecological validity (Rizzo et al, 2004), allowing generalizations to real-life situations. VR simplifies processes of environmental manipulation and gathering real-time physiological and neurological responses to design features. Our presentation outlines specific hypotheses, related experimental setups, and preliminary results of pilot research. We also discuss opportunities and constraints of using VR with older adults, including feasibility of combining VR with real-time neuroimaging. In conclusion, our interdisciplinary project lays a foundation for systematic study of spatial designs with brain function monitoring, which may result in important guidelines forincreasing physical and cognitive activity through architectural designs.

2. REFERENCES

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3. AUTHOR BIO

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A licensed architect and cognitive scientist, my research is at the intersection of environmental design and brain science. I study how features and attributes of the designed environment (from rooms to cities) affect creative processes and how spatial design can help people make better choices for their health and environmental sustainability. The main focus of my work is to better understand how people think-in-action. I examine psycho-spatial dynamics – intertwined (e.g., bi-directional) process of thinking and doing –and how cognition emerges from interactions with physical artifacts in the world. This stream of research is informed by knowledge from psychology (emobided, embedded, and enactive cognition) and neuroscience and shaped by 25 years of practice in architectural design and education. I am driven by questions of how designed environments can support human creativity and wellbeing and what are the physically situated processes involved in creative decision-making. My recent publications include topics in design and creativity theory, workplace creativity, and reconceptualizing designs for learning spaces and healthcare settings.

Agnieszka (Aga) Burzynska, Ph.D.

As a neuroscientist and psychologist, I study the mechanisms of decline, maintenance, and plasticity of cognition, brain structure, and function during the adult lifespan. I focus on assessing the effects of lifestyle interventions (randomized longitudinal control trials with exercise, dance, nutrition) on brain integrity, cognition, and everyday performance. I employ multiple magnetic resonance (MR) neuroimaging techniques to measure white matter integrity (diffusion imaging, T2 imaging, and MR elastography), brain volume, as well as spontaneous and invoked brain activity (resting state and task-related functional MRI) along with behavioral measurement of cognitive process. My main focus is on the relationships between physical fitness, physical activity and the brain and cognitive health. I am interested in studying both typical low fit and low active aging populations, as well as exceptionally fit and well functioning older adults; for example, we studied teh brain of Olga Kotelko, nonagenarian athletehttp://well.blogs.nytimes.com/2015/09/02/physed-4/?_r=0. With my collaborators we are one of the first to use objective measures of physical activity in combination with neuroimaging. A related area of my research focuses on the effects of long-term training on the brain, such as in professional dancers.