The Final Oral Examination for the Degree of

DOCTOR OF PHILOSOPHY
Psychology

Vinay Bharadia
2000    University of Calgary    M.Sc.
1998    University of Calgary    B.Sc.

“The Compensation Model of Working Memory in Healthy Aging: Structural and Functional Neural Correlates of the N-Back Task Over the Lifespan”

January 11, 2013
11:00 am
University Centre, Room A207a

Supervisory Committee:
Dr. Holly Tuokko, Department of Psychology, UVic
(Supervisor)
Dr. Stuart MacDonald, Department of Psychology, UVic
Dr. Brian Christie, Department of Medical Sciences, UVic
(Outside Member)

External Examiner:
Dr. Gabriela Spulber, Clinical Geriatrics, Karolinska Institute

Chair of Oral Examination:
Dr. Jeannine Carriere, School of Social Work, UVic
Abstract

The concept of age has undergone a shift from a non-specific measure of chronological age, to an identification of underlying biological, psychological and functional factors that lead to age-related changes over time. Loss of neurons (atrophy) and cognitive decline in healthy aging fit well in to this age paradigm. The aging brain is thought to undergo functional shifts in information processing in response to atrophy, which is conceptualised as a Compensation Hypothesis of cognitive aging. Using reaction time, accuracy and variability on the n-back task of working memory (behavioural), stereological cortical volume estimates (structural) and functional Magnetic Resonance Imaging (functional) approaches, this study documents whole brain, prefrontal and dorsolateral prefrontal cortex atrophy in older individuals. Further, increased variability, decreases in accuracy, but no change in response time in older participants was coupled with a posterior-to-anterior shift in processing confirming the Compensation Hypothesis of cognitive aging. The behavioural data combined with structural and functional findings, suggest an aging brain that neuropsychologically compensates over time by paradoxically placing further processing demands on a structurally compromised dorsolateral prefrontal cortex. This produces adequate but more variable and less accurate performance compared to younger brains; compensation occurs in age, but is not complete. Decision making research has pointed to the important role of emotion in judgement, and has implicated the orbitofrontal cortex as critical for this processing modality. The structural data in this study showed preferential atrophy in the dorsolateral prefrontal cortex, but spared cortical volume in the orbitofrontal cortex with age. Younger individuals took longer and maintained their
accuracy with increasing complexity during the n-back task, with older participants maintaining speed but responding more variably and less accurately with increasing task complexity. Decision making on the n-back task may have shifted with age from the pure processing power of the structurally compromised dorsolateral prefrontal cortex to increasing reliance on emotionally-guided decision making in the intact orbitofrontal cortex. These findings are discussed in relation to evolutionary pressures on the human working memory system, David Hume’s concepts of reason and the passions, and to the emerging field of Neuroeconomics.

Awards, Scholarships, Fellowships

2006 University of Victoria - Dr. Julius Scheicher Award

2006 – 2008 Alzheimer’s Society Doctoral Award

Presentations


**Publications**


