



**University  
of Victoria**

Graduate Studies

Notice of the Final Oral Examination  
for the Degree of Doctor of Philosophy

of

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MSc (University of Oregon, 2010)

BSc (University of Oregon, 2007)

**“Individual Differences in Personality Associated with Anterior Cingulate Cortex  
Function: Implication for Understanding Depression”**

Department of Psychology

Tuesday, March 15, 2016

10:30AM

David Turpin Building

Room A136

Supervisory Committee:

Dr. Clay Holroyd, Department of Psychology, University of Victoria (Supervisor)

Dr. Michael Masson, Department of Psychology, UVic (Member)

Dr. Farouk Nathoo, Department of Mathematics and Statistics, UVic (Outside Member)

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## **Abstract**

We humans depend heavily on cognitive control to make decision and execute goal-directed behaviors, without which our behavior would be overpowered by automatic, stimulus-driven responses. In my dissertation, I focus on a brain region most implicated in this crucial process: the anterior cingulate cortex (ACC). The importance of this region is highlighted by lesion studies demonstrating diminished self-initiated behavior, or apathy, following ACC damage, the most severe form of which results in the near complete absence of speech production and willed actions in the presence of intact motor ability. Despite decades of research, however, its precise function is still highly debated, due particularly to ACC's observed involvement in multiple aspects of cognition. In my dissertation I examine ACC function according to recent developments in reinforcement learning theory that posit a key role for ACC in motivating extended behavior. According to this theory, ACC is responsible for learning task values and motivating effortful control over extended behaviors based on those learned task values. The aim of my dissertation is two-fold: 1) to improve understanding of ACC function, and 2) to elucidate the contribution of ACC to depression, as revealed by individual differences in several personality traits related to motivation and reward sensitivity in a population of healthy college students. It was hypothesized that these different personality traits express, to greater or lesser degrees across individuals, ACC function, and that their abnormal expression (in particular, atypically low motivation and reward sensitivity) constitute hallmark characteristics of depression. First, this dissertation reveals that reward positivity (RewP), a key electrophysiological signature of reward processing that is believed to index the impact of reinforcement learning signals carried by the midbrain dopamine system on to ACC, is sensitive to individual differences in reward valuation, being larger for those high in reward sensitivity and smaller for those high in depression. Second, consistent with a previous suggestion that people high in depression have difficulty using reward information to motivate behavior, I find these individuals to exhibit relatively poor prolonged task performance despite an apparently greater investment of cognitive control, and a reduced willingness to expend effort to obtain probable rewards, a behavior that was stable with time on task. In contrast, individuals characterized by high persistence, which is indicative of good ACC function, exhibited high self-reported task engagement and increasing effortful behaviors with time on task, particularly for trials in which reward receipt was unlikely, suggesting increased motivational control. In sum, this dissertation emphasizes the importance of understanding the basic function of ACC as assessed by individual differences in personality, which is then used to understand the impact of its dysfunction in relation to mental illnesses.