



**University  
of Victoria**

Graduate Studies

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

of

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MA (University of Tehran, 2012)

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**“The Role of Event Related Potentials Originating in the Anterior  
Cingulate Cortex in Supporting Temporally Extended Hierarchically  
Structured Behavior”**

Department of Psychology

Tuesday, December 5<sup>th</sup>, 2017

10:00 a.m.

Clearihue Building

Room B007

Supervisory Committee:

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

Dr. Adam Krawitz, Department of Psychology, UVic (Member)

Dr. Olav Krigolson, School of Exercise Science, Physical and Health Education, UVic (Outside  
Member)

External Examiner:

Dr. Jan Wessel, Department of Psychological and Brain Sciences, University of Iowa

Chair of Oral Examination:

Dr. Gary McGillivray, Department of Mathematics and Statistics, UVic

## **Abstract**

Anterior Cingulate Cortex (ACC) is a brain area located in the frontal cortex. Although researchers do not agree about the function of this brain area, recent empirical evidence implicates this area in the control of foraging behavior. Foraging behavior involves planning hierarchically-organized, temporally extended sequences of actions. Importantly, the ability to identify likely and unlikely outcomes of actions are thought to be crucial for successful planning, and the capacity to learn from sources of information at different levels of hierarchy is deemed important to the acquisition of hierarchical behavior. However, the exact neural mechanism that support distinguishing between likely and unlikely consequences of an action, and in learning from information at multiple levels of hierarchy, remains elusive. In this dissertation, I present the results of two sets of experiments. The first set of experiments examines whether event-related potentials (ERPs) generated in the ACC are modulated by two types of feedback pertinent to two different levels of hierarchy. Specifically, I hypothesized that the reward positivity component of feedback-elicited ERPs, which is said to reflect the involvement of the ACC in learning from feedback, is modulated by positive feedback at two levels of hierarchy. The second set of experiments investigates the role of ACC in distinguishing likely and unlikely outcomes of an action for planning purposes. I hypothesized that the likelihood of possible outcomes given the currently taken action modulates the N2, a stimulus-locked ERP component that is said to reflect the ACC's involvement in event prediction. While the first set of empirical results did not reveal any modulation of reward positivity to positive outcomes at a higher level of hierarchy, the second set clearly supported a role for the ACC in distinguishing likely and unlikely outcomes of an action. Therefore, the results partially support the notion that the ACC is involved in planning hierarchically organised behavior.