The University of Hong Kong
Department of Psychology

Departmental Seminar

Oculomotor Signals in Visual Space Perception

Date: March 25, 2015 (Wednesday)

Time: 11:30 a.m. – 12:30 p.m.

Venue: CPD-2.42, Central Podium Level, Centennial Campus, HKU

Speaker: Professor Markus Lappe
University of Muenster

Vision is intrinsically linked to eye movements. Without eye movements vision would not be possible since the retinal image quickly fades away when stable. Vision, on the other hand, provides the information needed to guide eye movements and select targets. A large network of brain areas, cortical as well as subcortical, supports eye movement control. Many of these areas also serve visual and attentional functions. The flow of processing in this network is bi-directional. While visual scene analysis, target selection, saccade preparation and saccade execution form a feedforward process of oculomotor control, feedback loops from oculomotor structures inform visual areas about ongoing motor plans and influence the processing of visual input in these areas and ultimately visual perception.

Research on oculomotor feedback for vision has implicitly assumed a static situation: saccade planning, execution, and feedback processes occur in a fixed manner. However, the oculomotor processes that control of saccades are not fixed but plastic. The visual guidance of saccades is an open-loop control process because saccades are too brief (20-80ms in duration) to allow visual feedback during saccade execution. Hence, any errors in saccade performance, due for example to motor noise or muscle fatigue, become apparent to the visuo-motor system only after the saccade is finished. These errors are then evaluated and used to tune the open-loop controller for better performance of subsequent saccades.

Department of
Psychology HKU

This learning process is known as saccadic adaptation. Saccadic adaptation is usually studied by shifting the target of a saccade while the saccade is in flight. Consistent shifts in one direction (in or against the direction of the saccade) lead to increase or decrees of saccade amplitude. These amplitude changes were previously believed to take place exclusively in late motor circuitry, specifically in the cerebellum and brain stem. However, saccadic adaptation has recently been found to influence not only saccade performance but also visual space perception, further substantiating the intimate link between vision and eye movements.

Targets that are presented before an adapted saccade are mislocalized in the direction of adaptation. Moreover, observers that underwent saccadic adaptation mislocalize peripheral visual targets even when they continuously fixate. Some aspects of mislocalization across adapted saccades may be explained by mismatches between the saccade execution and the efference copy associated with the saccade. However, the adaptation-induced perceptual effects during fixation show that visual localization itself is modified in saccadic adaptation.

These dependencies strongly suggest that saccadic adaptation is not a simple-low-level process but that instead it operates at several levels of the oculomotor transformation between visual registration of a target and activation of the eye muscles. Moreover, the results suggest that the perceptual localization of an object in space is tightly linked to the motor processes that prepare one to look at this object.