City University of Hong Kong
Department of Biomedical Sciences
presents a seminar

"NEURAL ADAPTATION TO THE STATISTICS OF AUDITORY SCENES"

by

Dr Nicol HARPER
Department of Physiology, Anatomy and Genetics,
University of Oxford

Date: 1 June 2016
Time: 9.30am to 11.00am
Venue: Meeting room 2-130, 1/F, Block 2, To Yuen Building, CityU

Abstract

The features of the sensory world can span vast ranges, for example the intensity of perceptible sounds can span from sounds so quiet that they only move the membrane in the inner ear by a fraction of the width of an atom, to very loud sounds with more than ten billion times the energy of the quietest perceptible sound. In contrast, neurons tend to have only a limited dynamic range, for example in the auditory system they typically go from their minimum response level to the maximum response level as the energy in the sounds increases by just a factor of a thousand or so, and at intensities above or below this range their response tends to not change and hence the are insensitive. How does the nervous system maintain sensitivity to features that vary so much when neurons tend to have a limited dynamic range. Evidence suggests that one way the nervous system overcomes this challenge is through 'adaptation to stimulus statistics'. The nervous system assesses the statistics of the environment, for example the mean sound level of recent auditory input, and then adjusts its sensitivity such that its neural dynamic ranges span the range of the input it expects to be present. This neural adaptation to stimulus statistics may also be involved in ensuring neural representations stimuli change little under different stimulus conditions, for example that the neural representation of a spoken words remains approximately the same under different levels of background noise. In our investigations of the hypothesis of adaptation to stimulus statistics, we have shown that neurons in the auditory midbrain adapt their responses to the mean, variance and more complex statistics of sound level distributions, and that these adjustments maintain sensitivity of the neural population's representation of the sound input around the most commonly occurring sound levels in the incoming sound. This adaptation extends the range of sound levels that can be accurately encoded, fine-tuning hearing to the local acoustic environment (Dean et al. 2008). Furthermore, this adaptation occurs rapidly, within fractions of second after an increase in mean level (Dean et al. 2008), and the rate at which it occurs appears to be matched to the statistics of natural sounds, suggesting that neurons in the auditory midbrain predict the mean intensity of future sounds and adapt their responses appropriately. Finally, the midbrain projects to the higher neural regions of the cortex, and a neural model that includes this midbrain adaptation consistently predicts cortical responses better than the standard model for a range of synthetic and natural stimuli (Willmore et al. 2012), indicating that midbrain adaptation to stimulus statistics is an important phenomenon underlying cortical responses.

Contact

Prof. Jan SCHNUPP (3442-0549, wschnupp@cityu.edu.hk)
Mr Henry CHAN (3442-4438, henry.ch.chan@cityu.edu.hk)

All are welcome