



# OIST SEMINAR

**Ms Wen-Yi Wu**

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DATE: **Monday, May 9**

TIME: **13:00 – 14:00**

VENUE: **Meeting Room D015, Level D, Lab 1**

## **Shared response neurons in anterior cingulate and insular cortices engage in empathy-like behaviors of the rat**

### *Abstract:*

Studies have shown prosocial behaviors, including empathy-like acts, in rodents, but its neural substrates remain elusive. Evidence from human studies implicates the anterior cingulate (ACC) and insular cortices (InC) in pain empathy and thus predicts that certain neurons in these regions might be engaged by a subject's sensing itself in pain as well as by its sensing others in pain. The present study addressed this issue by recording single unit responses of the limbic cortical neurons while noxious radiant heat was applied to the rat itself or its nearby companion. Results showed that rats increased freezing behavior not only when receiving noxious stimuli but also when observing a companion being hurt. The observer rats also increased social approach to the companion. We found that 14.7% neurons in the ACC and 13.7% neurons in the InC responded to the pain stimuli applied to a nearby rat. However, such behavioral and neuronal changes were absent in the visual-deprived control group. Interestingly, among these vicarious pain responsive units, 57.4% and 62.7% in the ACC and InC also responded, with the same or opposite direction (denoted as shared- or anti-response, respectively), to its own pain. To investigate the functional significance of the shared- and anti-response neurons, we examined the correlation between neuronal activity and social approach or freezing behaviors. We found enhanced activities in both shared- and anti-response neurons prior to and during the social approach behavior. Furthermore, to test the pro-social significance of the shared- and anti-response neurons, we applied a behavioral paradigm relevant to empathy, in which a freely moving rat was trained to rescue a conspecific from a restraining trap (Bartal et al., Science 334: 1427, 2011). The shared-response neurons in the limbic cortex showed changes just prior to rescue behavior and did not show any change in the control conditions in which the restrainer was empty or had a toy rat in it. These findings suggest that observation of a conspecific in pain may engage the shared-response neurons in rat's limbic cortex and their activity may be related to social approach behaviors and contribute to prosocial rescuing acts.