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Visualization of neural activity of forager honeybee brain by IEGs

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One of the most interesting social behaviors of the honeybees is 'dance communication'. Foragers that successfully find a rich food source return to the hive and transmit the information of the location of the food source to their nestmates using a symbolic waggle dance. Although there are considerable amount of ecological researches for the dance communication, the underlying neural mechanisms remains mostly unknown. To elucidate the neural mechanisms of this remarkable ability, we aimed to identify active brain regions in the foragers that might be involved in dance communication and/or information integration during the foraging flight. To this end, we constructed neural activity mapping methods with the immediate early genes (IEGs). IEGs are genes expressed in a neural activity-dependent manner and thus can be used to visualize neural activity. We identified a novel IEG, kakusei, from honeybee brain and revealed that a specific mushroom body (MB) neuron subtype is preferentially active in in the forager brain. In addition, we revealed that the MB neuron activity depends on the foraging frequency, whereas the number of active MB neurons is related to the pattern of visual input received during foraging flight. Recently, we identified an evolutionally conserved IEG, Hr38, whose expression is higher than kakusei. Taking advantage of the high expression and long intron of Hr38, we are establishing novel neural activity mapping methods with high sensitivity and time-resolution. These methods will enable us to differentiate the neural activities related to the dance and foraging behaviour, which will lead to the identification of dance-specific brain regions and neurons.