Plenary 4

Neural Circuitry Governing *Drosophila* CO_2 Avoidance Behavior

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Drosophila exhibits a robust avoidance behavior to CO_2 emitted from stressed neighbors. A single specialized population of antennal sensory neurons detects CO_2 and relays information to a ventrally located V-glomerulus in the antennal lobe within the fly brain (Suh et al., 2004, 2007; Jones et al., 2007; Kwon et al., 2007). Little is known where higher brain centers translating the V-glomerulus reception into fear perception. Several lines of evidence indicate that 2 ventral-paired-lateral (VPL) neurons are necessary and sufficient for the induction of CO_2 avoidance behavior. (i) Polarity labeling and functional imaging indicated that VPL dendrites in the V-glomerulus and axonal terminals at dorsal frontal protocerebrum both exhibited transient increases in calcium upon CO_2 exposure. (ii) Temporal inhibition of neurotransmitter release from VPL neurons with *shibiri*^{ts} abolished CO_2 avoidance behavior. (iii) Activation of VPL neurons with channel rhodopsin 2 mimicked CO_2 exposure in eliciting the avoidance behavior. Using PaGFP tracing and MARCM labeling of individual neurons, we then mapped a comprehensive neural circuitry and several novel higher brain centers involving in processing CO_2 signal. Silencing or activation some of these V-glomerulus projection neurons did not alter CO_2 avoidance behavior. Together, these results suggests that specific individual projection neurons, rather than the entire population of projection neurons innervating the V-glomerulus mediate innate *Drosophila* CO_2 avoidance behavior.