Binary temporal pattern of odor induces chemotaxis in mites

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Chemotaxis for a chemical gradient in terrestrial arthropods is poorly understood. To understand its fundamental strategy in terms of sensori-motor relationship, we created binary odor patches provided with a minimum component of a spatial gradient by closed-loop odor stimulation on a locomotion compensator. Our model animal is the mould mite *Tyrophagus putrescentiae*, which tracks a gradient of dry yeast odor. We showed that mites localized binary food odor patches in proportion to odor concentration and patch size. The localization was performed by rapid returns from the outside into the odor patches, caused by abrupt turns correlated with the attractiveness of odor patches. Analysis of spontaneous locomotion characterized the turning maneuver by increasing angles of the first 2 counterturns after offset of odor across the edge of an odor patch with increased patch size as well as odor concentration. Distinct correlation between patch size and the duration from odor onset to offset due to nearly constant speed of the mites suggested spatiotemporal pattern of the modulated turnings are decided by the cumulative intensity over previous exposure to odor. We conclude that the chemotaxis strategy of mites is instant, transitory modulation of the spontaneous turning according to temporally integrated olfactory input across a spatial gradient.