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Dissecting the mechanisms controlling multimodal context-dependent behavioral states and transitions in *C. elegans*

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Maintaining behavioral states and switching between them is essential to optimize animal fitness, while impaired behavioral flexibility underlies prevalent clinical conditions such as mood or autism spectrum disorders. How multimodal context including internal states, past experience and immediate environmental cues orchestrate long-lasting behavioral state transitions is a complex, poorly understood question in the field. Leveraging on high-content behavior analysis of *C. elegans* thermoregulatory/foraging strategies and the arsenal of neurogenetic techniques in this model, we identified two new foraging behavioral states, able to improve animal fitness in complex/changing environments. First, we discovered the novel *Scanning* state on food as a trade-off strategy to jointly achieve two conflicting goals: thermoregulation (needing high locomotion to enable efficient thermotaxis) and food exploitation (needing low locomotion). Second, we discovered a novel *Glocal search* state off-food; a metabolically expensive state used only when high temperature puts extra time pressure on animals to find food. Surprisingly, we found that the transition to both *Scanning* and *Glocal search*, requires lifting multiple regulatory gates including tonic sensory neurons activity, neuropeptide expression and downstream circuit responsiveness. Therefore, the multisite gating mechanism, which we describe here for *Scanning* and *Glocal search*, respectively, represents an elegant solution allowing to (i) compute multiple inputs, (ii) filter short-lasting/noisy inputs and (iii) actuate long-lasting behavioral changes. Thus, we anticipate similar foraging states and mechanisms with the same intrinsic computational logic are used for other sensory modalities, in other species and might even potentially be extrapolated to behavioral flexibility-associated clinical conditions in human.

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