DIGITALVISION

BEHAVIOURAL NEUROSCIENCE

Swarming away from smells

> “inter-fly interactions alone can induce odour-avoidance responses in individual odour-insensitive flies”

Behaviours that are performed by groups, rather than by solitary animals, are known as collective behaviours. In some cases, such behaviours are thought to enhance sensing of potentially noxious environmental conditions, and thus survival, but the sensory pathways that mediate these behaviours are not clear. In a new study, Benton and colleagues show that *Drosophila melanogaster* exhibits collective odour-avoidance behaviour that is dependent on mechanosensory interactions between flies.

The authors created an arena, of which one side contained normal air and the other side contained 5% carbon dioxide — an aversive odorant. Isolated flies did not spend time avoiding the odour, but odorant-avoidance time increased as the number of flies in the arena increased, suggesting that avoidance of high carbon dioxide concentrations could be a collective behaviour.

The authors observed that flies often began to walk away from the odour after being in close proximity (< 25% body length) to a neighbouring fly — a situation that is more likely with a higher density of flies. Under these circumstances, high-resolution imaging of fly behaviour revealed that, during such an ‘encounter’, flies interacted with one another using the ends of their legs and wings. After an encounter, the ‘touched’ fly walked away from the ‘toucher’ fly on a certain trajectory depending on the appendage that was touched. Interestingly, touches from a metallic disc induced similar stereotyped walking responses, suggesting that these behaviours were elicited through mechanosensation (rather than through chemosensation or taste). Moreover, flies lacking *nompC* — which is involved in touch sensing — were less likely to exhibit a walking response following inter-fly encounters. Together, these findings show that the collective odour-avoidance behaviour is mediated by direct mechanosensory interactions between flies.

By screening different lines of flies in which specific mechanosensory neurons were selectively silenced, the authors identified the leg mechanosensory sensilla neurons as being necessary for the odour-avoidance response following fly–fly encounters. Furthermore, selective optogenetic stimulation of these neurons resulted in walking responses similar to those observed after encounters with other flies. Together, these data suggest that activity in the leg mechanosensory sensillum neurons is both necessary and sufficient to mediate walking responses in flies.

Finally, the authors asked whether inter-fly encounters increased odour avoidance by enhancing odour sensitivity. Strikingly, flies that were genetically unable to sense the odour spent more time avoiding the odour when they were among higher numbers of odour-sensitive flies. This result indicates that inter-fly interactions alone can induce odour-avoidance responses in individual odour-insensitive flies, without influencing awareness of the odour.

Overall, this study shows that leg mechanosensory sensilla neurons transduce a form of communication among flies that results in collective odour-avoidance behaviour. Furthermore, this communication enables individual flies that are insensitive to the odour to avoid the aversive stimulus.

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