Mind the obstacle: Lateralization of detour behaviour in two invertebrate species

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Cerebral lateralization is a ubiquitous trait documented throughout all the branches of the phyletic tree, including that of invertebrate species [1,2]. Brain asymmetries that occur at the individual-level (i.e., individuals show either a left or right bias) are associated with several computational advantages [3,4]; however, mounting evidence is collected in favour of population-level lateralization (i.e., most individuals show the bias toward the same direction) [5] that has apparent disadvantages (e.g., the predictability of the individuals’ responses). The adaptive benefit in the alignment of asymmetries within a population could lie in the facilitation of cooperation and defence behaviours and hence, should be especially evident in gregarious species [6,7].

We tested this hypothesis by investigating the detour responses of two sister families of invertebrate species: the cockroach (Gromphadorhina portentosa), a wingless hexapod, and the crayfish (Procambarus clarkii) a crustacean that can colonize new niches walking outside the aquatic environment. Both species navigate using the antennae, display aggressive interactions with conspecifics and multisensory social signalling [8-9], but cockroaches are considered gregarious while crayfish solitary.

In a formally identical labyrinth, animals could explore subsequent compartments. After the alignment of the body through a narrow corridor, a central physical obstacle forced a left-right detour choice in order to enter the next compartment. Few animals of both species displayed an individual-level lateralization (3 of the 102 cockroaches; 55 of the 202 crayfish). However, no population-level bias was evident in cockroaches, whereas crayfish showed a slight but consistent rightward bias in line with what observed in other vertebrate species [10].

Motivational rather than social aspects can account for the observed species’ differences. Whilst cockroaches were extremely fast and their navigational goal was to find a sheltered place where to hide, crayfish explored systematically and slowly the environment in order to find a physical discontinuity where to engage in burrowing activity.

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