Experimental investigation highlights the role of vision in fish schooling

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The level of order in animal groups on the move can display a wide range of variations, from fully disorganized aggregates to very regular networks. This collective motion could not be achieved if individuals were assessing their environment independently; instead, it emerges due to inter-individual interactions within the group. In fish schools, the collection of this information is based on vision and flow sensing with the Lateral Line System (LLS), a pressure gradient sensing organ. The respective roles and importance of these two mechanisms remain unclear.

Here we give experimental evidence that vision itself is necessary to school and that it allows to predict group phase transitions.

We show that the group structure of rummy-nose tetra (*Hemigrammus rhodostomus*, body length BL = 35±4 mm) exhibits distinct dynamics depending on the illumination of their environment. Free swimming assemblies of *ca.* 50 fish are recorded in a large tank (30 x 35 BL) where illuminance level ***E*** is cyclically modified over time from 0 to 900 lux (see Figure 1). We quantify the geometrical order with polarization (***P***) and milling (***M***) parameters, which capture global alignment and rotation: for low light exposure, we observe little to no order; intensity of the collective motion then increases with illumination, until a threshold.

Experimental studies on the role of vision in schooling are still rare, especially for large numbers of individuals, and could help us better understand the conditions of emergence and the nature of the collective motion in fish.

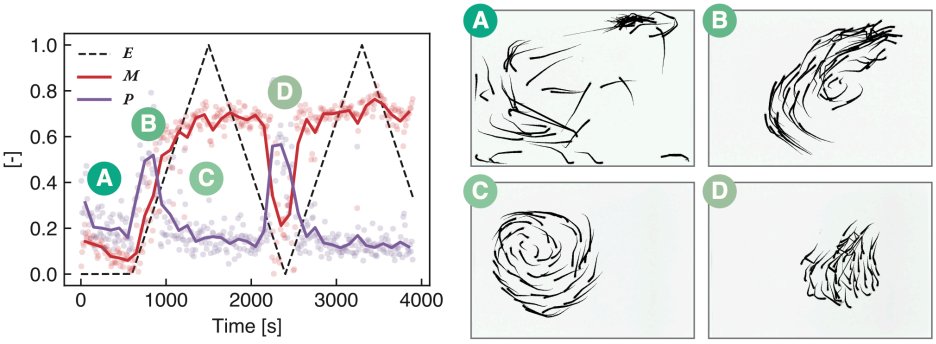

Figure 1: (*left*) Time signal of the polarization (***P***) and milling (***M***) parameters for a group of 53 fish experiencing variations of the illuminance (***E***, normalized) over a 1h time period.
(*right*) Snapshots of the school at times 5, 15, 23 and 38 min, exhibiting the strong correlation between organization level of the school and available visual cues.

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