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# Effects of behavioural properties on the perception of collective flow


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The human visual system is great at solving complex visual problems, but the underlying mechanics often remain poorly understood. Here, we investigate one of these complex problems—the visual perception of collective flow. This type of flow is created by a body of individual agents that show both collective and individual behaviours following a coordinated set of rules (e.g., flocks of birds, schools of fish, cars on highways). Ecologically, collective flow is particularly interesting due to its high variability and wide range of occurrences in nature. There are inanimate occurrences of collective flow (e.g., shaken metallic rods, nematic fluids), microscopic occurrences (e.g., macromolecules, cells, bacteria colonies), and richer manifestations with more intelligent organisms (e.g., insects, mammals, fish, birds, humans). Furthermore, collective flow can be portrayed by very low-level visual depictions while its highly scalable organizational complexity is expected to require higher-level understanding. Because of this we anticipate collective flow research to unveil insightful bottom-up and top-down interactions. We have built a collective flow engine using existing algorithms that capture biological collective behaviour. This engine or stimuli generator adjusts its behaviour based on properties assigned to individual agents. Here we looked at the human sensitivity of three properties in particular, zone of alignment, zone of attraction, and turning rate. Using Maximum Likelihood Difference Scaling (MLDS) we started to map the perceived differences between collective flow simulations. We find that observers are sensitive to changes in the turning rate and zone of alignment. Differences in zone of attraction were harder to perceive. The varying trends of the difference scales hint towards more complex underlying interactions. Our sensitivity to these behavioural changes demonstrates that there is ecological validity for collective behavioural processing, a novel and highly underexplored field of vision research.