New research reveals fish are smarter than we thought

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Are fish more intelligent than we thought? A new study from researchers in our Department of Psychology has highlighted the first evidence of 'parallel visual search' in zebrafish, with important health applications for stroke rehabilitation and in treatments for attention deficit disorders.

(Phys.org) —A new study from researchers in our Department of Psychology with colleagues at Queen Mary University of London has reported the first evidence that fish are able to process multiple objects simultaneously.

The discovery is proof not just that fish are more intelligent than their reputation for a 'three-second memory' suggests, but importantly paves the way for new medical advances that could help in stroke rehabilitation and in treatments for attention deficit disorders.

Published today in the journal *PLOS ONE*, the study is the first to identify 'parallel visual search' – the ability to pick out one object among

many – in zebrafish.

Visual search involves an active scan of an environment in order to look for just one object or feature. In everyday life we might relate to this in searching for an item on a supermarket shelf, looking for friends in a crowd or even identifying 'Where's Wally?'

Given the benefits of visual search in finding a mate, spotting a predator or searching for prey, the research team suggest that doing this efficiently by ignoring distracting items should be common among species. Yet, up until this point it had only been identified in primates, rats and pigeons. Without the frontal part of the brain in the neocortex, it was assumed that fish would have to examine every item, one after the other, to find the target, rather than assess the whole scene together.

As part of the study, 11 adult zebrafish were presented with different visual stimuli, in the form of different coloured circles on a computer monitor, over a period of six days to assess their visual processing abilities. Scientists taught zebrafish to associate food with a red disk, and then placed that disc among other distracting discs.

Lead author from the University Dr Michael Proulx explains: "Although vision seems simple and quick, it involves a lot of computational power to figure out where things are in a crowded environment. It is incredible to discover that the zebrafish brain, with its small size and simple structure, can seemingly find a target visually without getting slower. No matter how many items we added to the scene to distract the fish, they had no problem responding at the same speed every time.

"The zebrafish is an excellent model organism to study behavioural genetics and neurobiology thanks to its smaller brain and transparent skin. Now that we have discovered their mental sophistication, there is a great opportunity to discover the neural code and genetics of how

humans pay attention, and apply those findings to treatments for those with ADHD or strokes."

By uncovering the similarities between fish and humans in how they process visual information, the study now opens up other possibilities for using zebrafish for research.

Dr Matthew Parker from Queen Mary University of London, co-author of the paper, adds: "Fish don't deserve their reputation as the stupid branch of the animal family tree, the more research we do the more we find out that they are capable of quite complex learning and problem solving. This could be because being part of a shoal requires complicated interactions with their environments and quick processing of large amounts of information.

"Zebrafish are genetically surprisingly similar to humans and are incredibly useful to our studies of how genes influence addiction and psychiatric diseases, among other things."

The research adds to growing knowledge of fish intelligence that suggests they are capable of much more than we previously thought. Other studies have found that fish are able to pick the larger of two groups of objects, count up to at least four and have comparatively lengthy memories.

More information: Proulx MJ, Parker MO, Tahir Y, Brennan CH (2014) "Parallel Mechanisms for Visual Search in Zebrafish." *PLoS ONE* 9(10): e111540. DOI: 10.1371/journal.pone.0111540

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