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Press Release

How larger brains can predict social behaviours

January 18th, 2021 – Eager to understand how the environment can impact animal cognitive performance, a team of researchers discovered that, in cleaner fish from the Great Barrier Reef, the size of the brain is important for complex social decision making. The study published in **Nature Communications** suggests that large forebrains (the forward-most portion of the brain) enable individuals to adapt better to local environmental conditions, important data to add to the study of coral reef ecosystems.

Brain size varies greatly across vertebrates as the result of a myriad of selective forces exerted during evolution, as they had to adapt to the environments they were exposed to. But natural selection, that filters existing genetic differences, isn't everything when it comes to explaining adaptation. Phenotypic plasticity – the ability of the same collection of genes to produce different observable traits depending on the environment – is an alternative mechanism of adaptation to local environments.

The comparison between brains of many species suggests that larger brains confer better cognitive abilities, and, in fishes, studies report that phenotypic plasticity at the level of morphology can occur as a result of social or environmental changes. Looking at wild populations of cleaner fish from Australia (*Labroides dimidatus*), an international team of researchers, co-led by the principal investigator **Rui Oliveira** from Instituto Gulbenkian de Ciência, questioned whether variation in social complexity and relative size of different brain parts and their cells counts can predict brainpower in terms of cognitive ability.

Cleaner fish are the stars of one of the most classic stories of mutualism in nature. Their survival depends on the cleaning service they provide to their "clients", since they feed on parasites and dead skin of larger fish. The higher the number of cleaner fish, the higher the number of "clients" and so is the local social complexity. More social complexity entails an increase in the competition over access to "clients", that end up choosing between cleaners, especially if made to wait.

These premises inspired the team to simulate this environment in the laboratory using the ephemeral reward task. "It consists of presenting the focal subject with a choice between two plates that offer the same food reward, but one is retracted if not chosen first (ephemeral plate), while the other remains until the food on it is eaten (resident plate). The optimal solution in this task is to give priority to the ephemeral option", explains **Rui Oliveira**. "We collected cleaners from populations with high densities and found that they successfully learned to prioritise the ephemeral plate over the resident plate, whereas cleaners from low densities failed the task", adds the researcher.

The study then tested whether the observed successes and failures in the cognitive task can be explained by the size and cell numbers of specific brain areas. "We measured the brains of these fish and found that large forebrains, the more frontal parts of the brain, with higher computational power, are correlated

with a better performance in this task, in turn translating into better social competence. In other words, larger forebrains yielding a higher capacity for information processing may be what allows a better performance in complex social decision making in cleaner fish", reveals **Rui Oliveira**.

The results of this study capture key aspects of the social interactions in cleaner fish and open new doors for future research that explores in more detail the relation between the plastic features of the brain and the social competence in vertebrates. Bridging fundamental areas of Biology like development and evolution will be necessary to understand how social competence evolves in cleaner fish and ultimately in vertebrates.

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