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Shelling out for dinner: dolphins' foraging technique spreads socially among peers

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Dolphins, like us, live in social communities, offering opportunities to learn behaviours from others. Our study reveals that a dolphins' foraging technique called 'shelling' spreads among peers, suggesting that the nature of their social learning strategies is more similar to that of great apes, human's closest relatives, than previously thought.

A capture of 'shelling' — a bottlenose dolphin in Shark bay catching prey using an empty shell
Image credits: Sonja Wild (Dolphin Innovation Project)

What have you learned from your friends or family? Many animals, including humans, learn behaviour from other individuals of the same species through a process called social learning.

Offspring often rely on their parents to learn behaviour, as the parental generation is usually more experienced and skilled. In addition to such vertical social learning (parent to offspring), animals can learn from the same generation via horizontal social learning (peer to peer). Horizontal learning of foraging behaviour occurs more frequently in socially tolerant animals such as some great ape species — individuals tend to be closer in space during feeding, which provides more opportunities to learn behaviour from one another.

Dolphins are remarkably intelligent and social animals, serving as a great model for the study of social learning mechanisms. They show striking similarities with some great apes in terms of cognitive abilities and social systems, despite different evolutionary histories and living environments (land vs aquatic). They are long-lived, large-brained mammals with high capacities for innovation. Furthermore, some dolphin species form a particular type of community similar to chimpanzees', called fission-fusion societies, where

size and members of groups change over time, providing many opportunities for social interactions.

The social system and behaviour of Indo-pacific bottlenose dolphins (Tursiops aduncus) in Shark Bay, Western Australia, have been studied for over 35 years. These dolphins are renowned for various foraging techniques, ranging from intentional stranding to catch fish to using marine sponges as protective tools when digging in the sand for buried prey. Offspring tend to adopt their mothers' techniques through vertical social learning, as they are closely bonded with the mothers for years until weaning. However, thus far, there was no evidence that dolphins also learn foraging techniques horizontally from one another.

In this study, to extend our understanding of their social learning strategies, we investigated the spread of 'shelling', another remarkable foraging technique used by the bottlenose dolphins in Shark Bay. During shelling, dolphins chase a fish into an empty shell of giant marine snails, insert their beak into the aperture of the shell, lift it above the water surface and shake it to drain the water out of the shell until the fish drops into their open mouth.

Shelling behaviour is rare: we observed the event only 42 times (19 individuals) between 2007 and 2018. To investigate the spread of this behaviour among individuals, we integrated 12 years of association, environmental and genetic data on the dolphins into a social network analysis. We tested which of our three networks (social associations, genetic or environmental similarity among individuals) best explained the spread of shelling over time. We found that the spread followed the social association network, indicating that shelling spread via social learning among peers, that is, individuals spending a lot of time together.

This finding provides the first evidence of horizontal learning of foraging behaviour in dolphins, and toothed whales in general. Our results suggest that dolphins are indeed capable of learning foraging behaviour outside of the mother-calf bond. This sets an important milestone, as it suggests that the dolphins' cultural nature is even more similar to that of some great apes than previously thought. Social tolerance, and with its spatial proximity during feeding, likely provide opportunities for dolphins to observe others' behaviour and facilitates the social spread of foraging behaviour among peers.

The horizontal spread of shelling is also significant in understanding how dolphins may adapt to changing environments, as learning from peers allows individuals to rapidly acquire adaptive innovations. For instance, Shark Bay, where the bottlenose dolphins live, was subjected to an unprecedented heatwave in summer 2011, which had drastic consequences for the entire ecosystem, including the death of many giant marine snails. Interestingly, almost half of the 42 shelling events we observed over the 12-year period occurred during the two years after the heatwave. The large numbers of dead shells after the heatwave had very likely increased learning opportunities for shelling. Whether the horizontal spread of shelling among peers was a direct response of dolphins trying to find alternative ways to catch food in times of decreased prey availability remains an interesting avenue for further research. This will help us extend our understanding of how these social and intelligent animals can acquire adaptive behaviours in response to environmental changes.