

# Social rank may determine if animals live fast, die young

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Macaques on Thailand's Koram Island may engage in food-washing based on their social rank. The researchers set trays of sliced cucumber mixed with varying amounts of sand on the beach to observe how thoroughly the animals cleaned their food before eating it. They found that lower-ranked animals (pictured) first washed their cucumber slices in the ocean, often well past the point it was clean. Credit: Amanda Tan

Anyone who has picnicked on the beach has experienced the unpleasant crunch of a sandwich with a surprise helping of sand. But for primates, the tolerance for sand may depend on whether their energy is better spent reproducing and fighting rivals or on protecting their teeth from a mouthful of grit, according to a new Dartmouth study.

Social rank may determine whether animals prioritize immediate energy consumption over long-term health, or vice versa, the researchers [report](#) in the journal *eLife*. They observed the eating habits of long-tailed macaques on Thailand's Koram Island and found that the dominant and lowest-ranked animals briefly rubbed sand-covered food on their fur or between their paws before devouring it, along with most of the sand, and moving on to the next morsel.

Middle-ranked monkeys, however, having more time on their paws, carried their food to the water's edge and washed it in the sea to remove the sand. These animals often expended time and energy scrubbing their snacks past the point when they were clean and would even amble down the beach on their hind legs with their front paws full of food.

Nathaniel Dominy, the study's corresponding author and the Charles Hansen Professor of Anthropology at Dartmouth, says the findings provide insight into how animals—even those in hierarchical groups—choose [survival strategies](#) based on individual needs. The study supports the disposable soma hypothesis, which proposes that animals sometimes prioritize immediate survival and reproduction over longevity, Dominy says, adding, "Delayed gratification has its limits."

That may be the case for monkeys at the top and the bottom of the social ladder, for whom life is short and hard, Dominy says. As a result, these animals consume and conserve energy whenever they can. Existing

research shows that sand causes significant damage to macaque tooth enamel. But for [dominant males](#) especially, that may not be important in a life fraught with challengers.

"High-ranking males are constantly lunging at or chasing other males, behaviors that maximize their siring of offspring. So, they need to eat rapidly to make up for that energy expenditure and that's exactly what we saw them doing," Dominy says.

"They just stuff food into their mouths—sand be damned—because they don't have time to walk to the water. It's the urgency of now that matters, not their teeth. To humans, it seems like a shrewd calculation."

The monkeys that wash their food might instead be playing a long game, says Amanda Tan, the study's co-corresponding author and an assistant professor of anthropology at Durham University. Tan worked on the project as a postdoctoral scholar in Dominy's research group at Dartmouth.

"We think these animals invest a lot more time in washing their food because they cannot afford to damage their teeth and compromise their longevity," Tan says. "This strategy could allow them to maximize their potential reproductive success by living longer and producing more offspring over their lifetime."

The findings also could shed light on how the wear and pitting observed in the fossilized teeth of early humans relate to social structure and access to water, Dominy says.

"What if tooth wear is telling us about rank, not food properties," Dominy asks. "If we find more variable wear on a male hominin tooth, the classic interpretation is that it's the result of a varied diet. We ought to consider the possibility that he was eating quickly and couldn't be

bothered to clean his food. Or maybe he lived in an area that was historically arid. We have cause to be more open-minded about variable tooth wear."

To observe the macaques' eating habits, Tan and the study's first author, Jessica Rosien '21, arranged plastic trays on the beach that contained cucumber slices. The slices were either on their own, placed on top of sand, or buried in sand. Rosien and Tan recorded the animals every day for six weeks as they foraged for cucumbers in the trays, capturing nearly 1,300 instances of food-handling by 42 individual macaques.

The monkeys that washed their food devoted an average of five seconds to over a minute to each cucumber slice—often washing multiple slices—while the average amount of time spent just brushing sand off a slice was effectively zero, the researchers report. That time makes a difference. In lab trials with sand-coated cucumbers, the researchers found that washing removed 93% of sand and brushing removed only 75%.

The researchers determined [social rank](#) using established methods of observing how the animals interact. But the social order was not subtle, Rosien says. She recalls a low-ranking male that, rejected by his peers, spent his time sitting next to her on the beach. A high-ranked female would fearlessly challenge other macaques for their cucumbers and steal anything Rosien left unattended, including her backpack of supplies.

"I loved getting to know the different monkeys' personalities over time and I definitely got a sense of the impact of social rank," she says.

Before the study, Tan worked on Koram Island for years observing how the macaques developed skills using tools through social learning. She knew that some animals washed their food while others did not. It was Dominy who wondered if there was a rank-based trade-off between

getting calories quickly versus preventing tooth wear, Tan says.



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"To our knowledge, no one had tested the hypothesis that food-washing served as an adaptive function for removing grit," she says.

Food-washing among primates is not common, Dominy says. The Koram Island macaques were first observed doing so after the 2004 Indian Ocean earthquake and tsunami. Their habit became a draw for tourists, who, before authorities put a stop to it, would throw fruit on the beach from boats to watch the animals wash it in the surf.

The other known instance is among the Japanese macaques on Japan's Kōjima Island. In the 1950s, researchers studying the animals lured them toward the beach with wheat and sweet potatoes to observe them more clearly.

In 1953, a young female named Imo first picked up a sandy sweet potato and washed it in a stream. Five years later, the other animals had taken up the practice, washing their food in the sea. Today, 92% of the Kōjima Island macaques wash their food.

"I love the story of Imo," Rosien says. "It shows how an individual can cause a shift in a whole population. To see such a significant advance in real time makes it easier to understand how small changes can lead to big changes."

The spread of a similar habit in two independent populations separated by 50 years and 5,000 miles speaks to the value of culture, Dominy says.

"You have to be experimental and entrepreneurial to invent a new behavior out of whole cloth, but it has to be clear enough that other individuals will understand its purpose and copy it," he says. "And they have to be smart enough to recognize when another animal has figured out something valuable. That's what culture is—seeing the value of a new behavior and adopting it."

The value for the macaques of washing their food was considered so obvious, no one had studied it before, the researchers write in their

paper. "Even if something seems intuitive, it's still important to be curious, ask questions, and test assumptions," Tan says.

"In this case," she continues, "our study provides a fuller picture of the various trade-offs that animals may juggle relative to their place in a [social structure](#) and gives us a better understanding of how that leads individuals to behave distinctly."

**More information:** Jessica E. Rosien et al, Food-washing monkeys recognize the law of diminishing returns, *eLife* (2024). [DOI: 10.7554/eLife.98520.1](#)

Provided by Dartmouth College

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