

How status sticks to genes

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Those at the bottom of the social ladder are known to live shorter and sicker lives than those at the top. And the stress of life at the bottom may have long-term health effects that even upward mobility can't undo, according to new research in monkeys.

The findings of a team led by researchers at Duke University and the University of Chicago are from a long-term study of 45 female rhesus macaques kept at the Yerkes National Primate Research Center in Atlanta. They suggest that those who move up in the [social hierarchy](#) still show the effects of their once-lowly status at the cellular level, even after they rise in rank.

These captive female macaques jockey with each other for status until a pecking order is established and everyone knows their place. The [dominant females](#) generally do whatever they want, getting first dibs on food and space, frequent grooming, and pushing others around to show who's boss. Subordinate [females](#), on the other hand, must move out of the way and wait their turn.

At the beginning of the experiment, the researchers put unrelated females who didn't know each other into groups of five, introducing them one by one. The macaques sort out who's in charge by order of seniority, with earlier arrivals outranking those who join the group later.

The latecomer 'newbie' females inevitably got picked on, cowering and backing down instead of standing their ground. Then all that changed. After a year, the researchers shuffled the groups and re-introduced the monkeys in a different order so that a new social order was established.

As the group memberships changed, a macaque's status within her new group changed too. Some monkeys who were targets before moved up the ranks and became more dominant; others moved down and became more submissive.

Then the researchers looked at the monkeys' blood. In a study published in 2016, the team found that a female's rank affects how thousands of genes turn on and off within her blood cells, especially the immune genes involved in fighting infection. In low-ranking females, many of

these genes are 'stuck' on in a way that leaves their immune systems easily riled up by potential microbial invaders, as if fixed in overdrive.

The results of the new study show that a monkey's current social rank isn't the only thing that matters—her past rank plays a role too.

The team identified 3,735 genes whose activity was still influenced by a monkey's former place in the hierarchy, regardless of how her position changed later.

Females who fell down a rung or two on the social ladder showed the effects of their recent demotion on their [genes](#), said co-author Luis Barreiro of the University of Chicago.

But what was surprising was that even when females moved up in the world, the harassment they suffered in the past still had lingering effects on their [immune genes](#) that followed them as they climbed the social ladder.

"We all have baggage," said co-author Jenny Tung, a professor of biology and evolutionary anthropology at Duke. "Our results suggest that your body remembers having low social status in the past," Tung said. "And it holds on to that memory much more than it would if things had been really great."

Published October 14 issue in the journal *Proceedings of the National Academy of Sciences*, the research sheds light on how stressful social experiences can get 'under the skin' and influence long-term health.

This "suggests that there are 'biological embedding' processes at work even in adulthood," Tung said.

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National Science Foundation, Canada Research Chairs Program, Natural Sciences and Engineering Research Council of Canada and the North Carolina Biotechnology Center.

More information: Joaquín Sanz et al, Social history and exposure to pathogen signals modulate social status effects on gene regulation in rhesus macaques, *Proceedings of the National Academy of Sciences* (2019). [DOI: 10.1073/pnas.1820846116](https://doi.org/10.1073/pnas.1820846116)

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