

# Robust systems persist in response to mutations

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At first glance, robustness and evolvability—two keys to the continued existence of life—look incompatible. Living things need robust genes; otherwise, any mutation could spell death. At the same time, a species needs to exploit mutations to evolve, adapt, and survive in a changing world.

A study out today in the journal *Science* suggests that not only are robustness and evolvability compatible, they in fact go hand in hand.

"They seem to be opposite traits almost," says University of Zurich biologist and SFI External Professor Andreas Wagner. "If a system is robust, it will persist in the face of mutations. But if you actually want to be able to evolve, you need to be able to vary in response to mutations. That's the problem right there."

But Wagner and postdoctoral fellow Joshua Payne argue that far from being opposites, robustness and evolvability are two sides of the same coin. Their study focused on 104 mouse and 89 yeast transcription factors, special proteins responsible for regulating gene expression.

To do their jobs, transcription factors interact with DNA sequences called binding sites; usually a given transcription factor can attach to more than one binding site. Payne and Wagner found that the more sites a transcription factor can bind to—and the more one can "hop" from one compatible site to the next through single mutations—the more robust the transcription factor's function.

What's more, that [robustness](#) makes it easier for a population of, for example, mice or yeast to find new, potentially useful mutations—the key word being "population." When their transcription factors are robust, each member of a group can perform the same biological functions despite great diversity in the underlying binding-site DNA. In turn, their offspring will have an even greater diversity, most maintaining the original [transcription factors](#)' functions, some with harmful [mutations](#), but some with new, valuable functions.

The project is part of Payne and Wagner's efforts to understand the origins of biological diversity. Invoking the words of the Dutch botanist Hugo de Vries, Wagner notes that "natural selection can explain the survival of the fittest, but it cannot explain the arrival of the fittest."

**More information:** The Robustness and Evolvability of Transcription Factor Binding Sites. Joshua L. Payne and Andreas Wagner. *Science* 21 February 2014: 343 (6173), 875-877. [DOI: 10.1126/science.1249046](https://doi.org/10.1126/science.1249046)

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