

# Hard to solve a Rubik's cube? Try the adaptive toolbox theory on rationality

November 2 2017

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Credit: Radboud University

Contrary to what cognitive scientists long thought, the adaptive toolbox theory - a theory about human rationality - contains an NP-hard problem which asks for demonic computational powers just like the travelling salesman problem and the Rubik's Cube. Maria Otworowska, Iris van Rooij, and colleagues from Radboud University publish these findings in *Cognitive Science*.

NP stands for nondeterministic polynomial time. The calculation time required to solve any NP-hard problem grows exponentially as the size of the problem grows. For the salesman problem this would be the number of cities, and for a Rubik's Cube the number of squares in the side planes of the cube.

The 'adaptive toolbox [theory](#)' defines human rationality in terms of a degree of adaptation of decision strategies to different environments. When adapting a strategy to the environment leads to a 'good enough' decision, it is said to be ecologically rational.

The two classical theories on rationality (sales man and Rubik's Cube), which are based on logic or probability theory, are notorious for their assumption of such demonic calculation power. It was thought that this did not apply for the adaptive toolbox theory: an advantage, because it makes the theory easier to scale to the real world.

But, the Nijmegen [cognitive scientists](#) now publish mathematical evidence for the fact that ecological rationality also contains an NP-hard problem, namely in the adaption process itself.

## The best theory on rationality?

"I expect that this finding will make some waves in the field," says last author Iris van Rooij. "There are three groups of rationality theoreticians: logicists, Bayesians, and heuristicists. The heuristicists were in pole position for a long time, so to say, but with our results they have now lost their lead. The question remains open which theory on rationality is the best one. We have to get to work!"

Van Rooij believes that the results have far-reaching consequences. Not only for discussions about questions like 'are people rational or irrational,' and 'is rationality a viable standard,' but also because it opens new research lines on the co-evolution of environment and brain. The article enables advancements in research on [rationality](#) in the real, complex world, instead of the artificially simple experiments in the lab.

**More information:** Maria Otworowska et al. Demons of Ecological Rationality, *Cognitive Science* (2017). [DOI: 10.1111/cogs.12530](https://doi.org/10.1111/cogs.12530)

Provided by Radboud University

Citation: Hard to solve a Rubik's cube? Try the adaptive toolbox theory on rationality (2017, November 2) retrieved 13 May 2024 from <https://phys.org/news/2017-11-hard-rubik-cube-toolbox-theory.html>

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