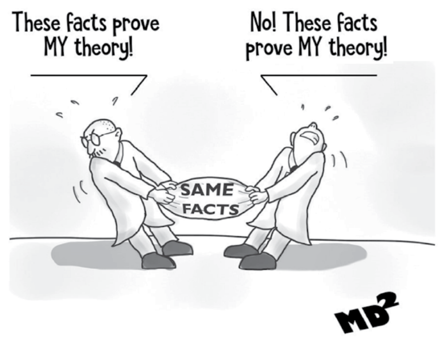
Bringing out the Occam's razor in peer-review

We will now explicitly ask reviewers to flag up to us and authors whether a simpler model or theory could explain the experimental data in a given manuscript.

The Occam's razor is a philosophical tool that advocates the principle of parsimony when deciding which one of two arguments is to be preferred. It was already in use by ancient Greeks, more famously by Aristotle, then adopted in Europe in the late Middle Ages through Arabic scholars and was widely used by the Scholastics. The principle is identified with William of Occam, a theologian who was tasked with looking into the theological implications of a Catholic Church possessing material wealth. (For the record, he concluded that the Church should remain poor following the teaching of Frances of Assisi; the Pope was not impressed and William took refuge under the King of Bavaria.) This principle of parsimony was then taken up by natural philosophers (later, scientists) to help make sense of experimental observations. There are several formulations of the principle of parsimony, but probably the most relevant to science used by William states: no plurality should be assumed unless it can be proven by experience. In other words, there should be a reason (some experimental evidence) to introduce a more complicated theory or model. From Newton through Einstein, many scientists have spoken in favour of applying this philosophical tool in science[1].

Despite this, it has been recently eloquently argued that an 'inverse Occam's razor' is taking hold in certain scientific quarters — it's the idea that by overcomplicating theories and models, aligning them with the catchword du jour, one can come up with something sensational and exotic that is more intellectually attractive and subsequently more likely to secure good grants and be published in high-impact-factor journals[2]. Unfortunately, this denunciation is not a lone voice. Through our interactions with the academic community, we frequently come across the same concern. This is a serious problem we ought to confront, because it undermines a fundamental tenet of the scientific method. It's a hindrance to advancing our knowledge of the physical world.



Credit: Matteo Di Ventra

From now on, at *Nature Nanotechnology* we will include the following piece of instruction to reviewers: In the spirit of the Occam's razor, do you think the experimental data can be explained using a simpler model or a simpler theory? If so, please provide your rationale and potential control experiments that could disambiguate against alternative explanations.

We do not have the presumption that these few lines will solve the problem — and we are not a police corps either — but we feel the responsibility to contribute to redressing this dubious drift. It's also a rather straightforward step for us to take, because it is already not unusual that reviewers raise questions over the interpretation of experimental data, proposing an alternative (many times simpler) explanation. When this happens, the burden is on the authors. They should test out the existing model to fit their data and quantify the discrepancy from it. At that point, a suitable adjustment can be offered that is valid under the specific experimental conditions of the paper. If disambiguation between two alternatives is impractical at the time of peer-review, we may force authors to recognize the possibility of a different explanation. The aim is to echo in the final paper the scientific argumentations that have arisen during peer-review. In some cases, we may commission a linked News & Views piece to a reviewer to offer our readers an independent view of the paper as well. However, we are now explicitly asking reviewers to bring out their Occam's razor.

Importantly, a new model or a new theory must be able not only to fit the data, but also to make predictions that can be experimentally tested. Therefore, authors should be able to propose experiments that would (hopefully) corroborate their theory or model. No predictions, no possibility of corroboration, no theory; it's as simple as that if you don't want to call it faith[3].

There is no shame presenting a striking experimental observation and having only a tentative idea of what is happening, so long as all relevant hypotheses have been tested out and have succumbed to the experimental evidence. (In a sense, this is what happened to Max Planck when he had to introduce quantization ad hoc in order to explain the black-body radiation; or Richard Smalley when admitting he had little idea how C_{60} could form.)

A final note of caution: philosophers of science have spoken both in favour and against the principle of parsimony in science[4]. Sometimes, preserving a plurality of views over an unknown phenomenon keeps the collective intellectual environment ready for a more comprehensive understanding. But we have probably come a bit too far. ❐

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