Correspondence

Stats: how useful is the treatment?'

I disagree that the current misuse of *P* values in biomedical science could be solved by 'retiring' statistical significance (V. Amrhein *et al. Nature* **567**, 305–307; 2019).

Like it or not, some of the blame for current practices lies in researchers' infatuation with simply disproving the null hypothesis. They often see this as a more 'objective' way of doing science: collect data and let the decision about its importance be made by statistics.

The real question is whether a treatment effect is important, not whether it differs 'significantly' from a control. To answer this, the researcher should justify beforehand how large the effect size needs to be. Then, if a 10% improvement over the control is required, the probability that this has been attained can be calculated from the data using familiar statistical tools for hypothesis testing and sample-size determination.

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Stats: researchers' lust for certainty

Testing for statistical significance should be an aid to interpreting scientific results, and — when applied sensibly — to decision-making. It should not be a mindless quest for verification (see V. Amrhein *et al. Nature* **567**, 305–307; 2019). In my experience, the correction of *P* values for multiple testing — a valuable tool in the fight against *P* hacking and in the proper interpretation of genome-wide association studies, for example — is being comparably abused through ignorance.

Too often, I find myself up against criticisms from reviewers who draw no distinction between tests carried out on evidence-weighted, mechanistically legitimate risk variables and tests applied to ad hoc collections of measurements (roughly akin to grandmothers' dogs' tail lengths). The distinction was spelt out more than 20 years ago (T. V. Perneger *Br. Med. J.* **316**, 1236–1238; 1998). That nobody took any notice shows how tight a grip the lust for certainty — neatly dubbed by Amrhein and colleagues as "dichotomania" — has on a researcher's psyche.

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Stats: choose meta-analyses

Valentin Amrhein and colleagues correctly point out (*Nature* **567**, 305–307; 2019) that *P* values should not be used to classify scientific results as significant or non-significant (widely misinterpreted as 'true' or 'not true', respectively). However, scientists — in their dispositional revulsion towards subjectivity — routinely make a broader error.

Too many biomedical researchers still believe that single papers prove scientific points. If that were the case, the *P* values associated with the experiments would be important, and we could argue about what they mean and where significance thresholds should be set. Clinical scientists were disabused of this idea years ago: the results of meta-analyses routinely make a mockery of the conclusions of individual experiments.

Most high-profile preclinical papers describe multiple experiments that either depend on each other or converge on a conclusion (see J. S. Mogil and M. R. Macleod *Nature* **542**, 409–411; 2017). The *P* value of each experiment is hardly relevant: the question is how many independent experiments were done in which the observed effect supports the conclusion. Even then, that conclusion would be valid only for the set of circumstances pertaining to those particular experiments.

For every conclusion, there is evidence for, evidence against, and uncertainty as to how far it can be generalized. Results are always provisional, *P* values or no.

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Cut risk of chemical factory explosions

The huge explosion in March at the Tianjiayi Chemical Company's plant in China could have been prevented had safety lessons been learnt from previous accidents (see Z. Tang *et al. Nature* **525**, 455; 2015).

China's chemical and petroleum industry has grown markedly since 2003 (see, for example, go.nature.com/2uatdxa). The number of chemical accidents has risen as a result. The problem needs to be tackled on several fronts, including through stricter legislation and more comprehensive risk assessment and control, backed by international collaboration on scientific research and technology (B. Wang *et al. Sci. Total Environ.* **643**, 1–11; 2018).

Implementing these tightened safety standards is essential as Chinese chemical factories proliferate into southeast Asia, Africa and South America under the auspices of the Belt and Road Initiative and the Asian Infrastructure Investment Bank. International compliance with the Strategic Approach to International Chemicals Management (go.nature.com/2ubn9v5), a global policy framework hosted by the United Nations Environmental Programme, will be crucial to protecting these developing regions.

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Olive harvest at night kills birds

From October to January, millions of birds from central and northern Europe winter in the Mediterranean basin. Suction olive harvesting at night kills these legally protected birds on a catastrophic scale as they rest in the bushes. This year, the practice has been stopped by the Andalusian government in Spain, where an estimated 2.6 million birds used to be vacuumed up annually (see go.nature.com/2zkomts). Other big olive-producing countries should follow their lead.

Some 96,000 birds die in Portugal annually as a result of night-time olive harvesting (see, for example, go.nature.com/2zgy7ml). The Portuguese government has so far taken no action; France and Italy remain silent.

The trees are stripped at night because cool temperatures help to preserve the olives' aromatic compounds. Local governments and local, national and international communities urgently need to assess the impact of the practice and take steps to end it.

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CONTRIBUTIONS

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