Paper of the Quarter

Outstanding 3R-Research from North Rhine-Westphalia
- 4th Quarter of 2025 -

The quarterly distinction 'Paper of the Quarter' of the 3R-Competence Network NRW recognizes outstanding contributions to the 3R principles. We are delighted to announce the winners for the fourth quarter of 2025.

Congratulations to

Christoph Waterkamp & Daniel Hoffmann

University of Duisburg-Essen

for their publication

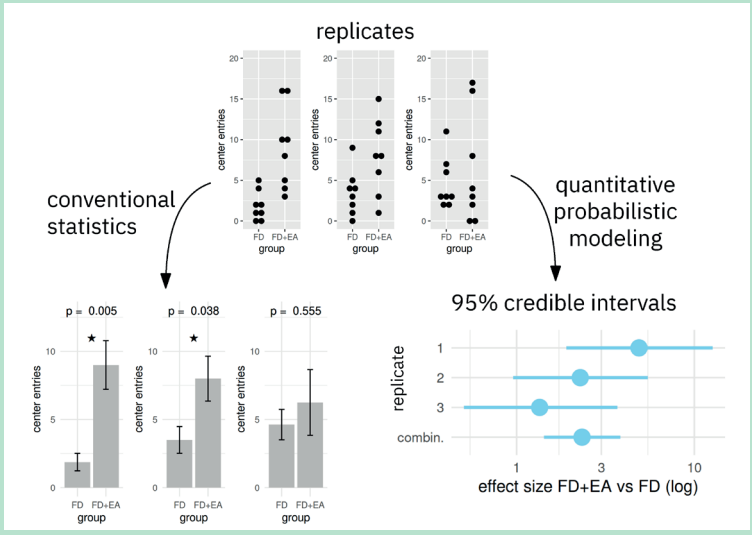
"BAYAS: simplifying access to Bayesian analysis for biologists"

The "Paper of the Quarter" award was given to their publication because they strive in a special way to further develop the 3R principle—"Replace, Reduce, Refine"—which has been applied in laboratory animal science for more than 60 years.

The paper "BAYAS: simplifying access to Bayesian analysis for biologists" presents a freely accessible, web-based tool that enables biologists to **access Bayesian analysis workflows in a low-threshold, code-free** way. Particularly noteworthy are the **well-founded sample size planning and the transparent, reproducible statistical analysis** of biological data. As a result, experiments can be planned more efficiently, unnecessary repetitions can be avoided, and **animal experiments in particular can be reduced**.

▶ You can read the original article here

Waterkamp, Christoph, and Daniel Hoffmann. "BAYAS: simplifying access to Bayesian analysis for biologists." Bioinformatics (Oxford, England) vol. 41,6 (2025): btaf276.



In conventional statistics (left, below), p-values are not robust, there is no indication of uncertainty, biological interpretation is difficult and it cannot be updated. **In quantitative probabilistic modeling** (right, below), on the other hand, credible intervals are more robust, there is indication of uncertainty, biological interpretation is simple and updating is easy. Figure is kindly provided by the author Daniel Hoffmann.

Q&A with the Winners
- 4th Quarter of 2025 -

How did this research come about?

Biological experiments often harm animals, an idea that I find difficult to stomach. In some cases, such experiments could be justified because there are no alternatives and with the gained knowledge greater harm may become preventable in the future. But even such essential experiments should be optimized to generate this knowledge with the smallest number of animals possible, which corresponds to the "reduce" in 3R. However, my experience in numerous collaborations in biomedical research shows that experiments there are not optimized in this sense. Specifically, biologists tend to use non-optimal statistical methods to plan and evaluate experiments, although better methods are well-known. The main obstacle is that these better "Bayesian" methods require programming and math skills that are not common among biologists. So it seemed quite natural to develop a tool that makes access to these Bayesian methods easier by at least partially eliminating this obstacle.

What is the contribution of this research to the 3Rs?

The main contribution of BAYAS is to the "reduce" aspect of 3R by maximizing information gain per animal. BAYAS achieves this in a number of ways: it facilitates use of prior knowledge in analyses, it encourages criticism of the statistical models underlying the analyses and enables formulation of statistical models that more accurately reflect features of the studied biological system. Moreover, analyses reveal uncertainty and are more robust, and are hence more reproducible than conventional null-hypothesis significance tests with p-values. BAYAS offers these advantages in the planning phase when biologists estimate the necessary number of animals, and in the evaluation of the actually measured data. These statistical analyses in planning and evaluation are more complex than the application of the conventional black-box statistics that biologist are trained in. For better reproducibility, BAYAS therefore also supports accurate reporting of these analyses.

What is your next 3R research question that you would like to answer?

BAYAS offers a set of practically important statistical models, but this set is limited and does not suffice to cover all experimental designs. For instance, so-called multilevel models are highly relevant but not yet implemented in BAYAS. The problem there is that handling these more complex models requires more user skills, more can go wrong, and analyses are more generally more difficult. Undoubtedly, this will be an application area for artificial intelligence. Another limitation is that some bigger models strain computational resources. This is particularly relevant for the planning phase where we have to apply the same models over and over. Here we will test a new approach called amortized Bayesian inference, which promises to make such analyses more affordable again.

What is "Paper of the Quarter"?

The quarterly distinction „Paper of the Quarter" serves to recognize outstanding publications in the field of 3R principle of the 3R Competence Network NRW. The aim is to recognize the diversity of research achievements and in particular those publications for which the extraordinary quality cannot be adequately reflected by quantitative evaluation criteria such as the Journal Impact Factor (JIF). A high JIF is not an exclusion criterion, but it is not a selection criterion either.

The award is presented as part of a quarterly open competition. The decision on the publication to be awarded is made by the network's Steering Committee which is formed by the representatives of the eight faculties of medicine in NRW. Each location represented on the Steering Committee has one vote, so that the winner is determined by a simple majority of votes. The selection can be made if at least 50% of the site representatives are present at the relevant meeting. The selected paper will be made visible as „Paper of the Quarter" by the network. The award is also recognized with a certificate.

For more information and submissions for the next round **until August 31st, 2026**, please visit

▶ **PAPER OF THE QUARTER**

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