

### Editorial: Changing science, the next time around.

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Every post-doc at some point during their scientific career tried to repeat a previously published discovery but failed to replicate their findings. A survey of 1500 scientists, conducted by the journal *Nature*, stated that more than 70% of researchers failed in reproducing the results and more than half have failed in to reproduce their own results.<sup>1</sup> This irreproducibility also has a hefty price tag, estimated at approximately \$28,000,000,000 (US\$28B)/year for preclinical research within life sciences alone.<sup>2</sup> This replication crisis is an ongoing problem in science but new strategies to address this crisis have been initiated in the last years.

While replication within a study is essential, it is not common practice that research is replicated by independent researchers. This could be due to the fact that current method sections are frequently just an itemized lists instead of a scientific recipe that describes in detail the experimental setup and analysis for others to undertake.<sup>3</sup> In addition, incentives to publish replications are low, journals can be reluctant to publish negative findings and funding agencies may look more towards innovation instead of replication and validation.<sup>1,4</sup> To address these issues, many journals have now incorporated guidelines to ensure that the findings are reproducible, and sufficient information is available for readers to reproduce the work for themselves.<sup>5</sup> To encourage replication studies, in 2016 The Netherlands Organization for Scientific Research (NWO) launched the world's first national research fund focused towards replication studies to test whether scientists can reproduce important results, and since then other scientific organizations, such as the National Science Foundation (NSF), have adopted similar strategies.

The increasing support for replication studies also raises the question about how many times a research finding needs to be replicated. It might even be that further replication is not needed, but that researchers are just unaware of prior replication studies. As many reports of randomized trials do not use systemic reviews and each report cites less than 25% of relevant similar previous trials.<sup>6,7</sup> In addition, routine replication might actually not be beneficial as constant findings might actually not be 'true' but based on consistent errors in study design, methods, or analytical tools. The use of multiple approaches could help distinguish artefacts from consistent results.<sup>8</sup> The combination of replication with the incorporation of novel techniques already shed new light on several dogmas. For instance, with the advances in *in vivo* microscopy a new 'organ' was recently identified as the human interstitium that was previously overlooked<sup>9</sup>, and with the increased availability of multiparameter assays, such as mass cytometry (CyTOF) it was found that cord blood is not a representative for postnatal immunity, as previously believed.<sup>10</sup>

The need to replicate prior studies is detrimental for good science and has in recent years gained more support from journal editors and funding agencies. Better description of the material and methods in reports and increased awareness and citation of prior replication studies is necessary to optimize replication studies and to assess the need for further replication. Replication with incorporation of multiple approaches, such as new techniques, might alter long standing beliefs when we look upon it the next time around.

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