

Letter

Future scientists can provide future solutions

There seems to be rumble in research; widespread funding fetishism, irreproducibility and the lack of quality control by peer-reviewers recently gained attention in the media. October's article *Trouble at the Lab* in *The Economist* tried to support its provocative headline by revealing sore spots in scientific research, but fails in its how-to-fix-it. To overcome irreproducibility and poor quality checking concerning rashly published miracles, universities should therefore investigate possibilities of funding graduate students in reproducing already existing results. This disarmingly simple approach has the promise of tackling nonreplication and awry trust by involving future scientists as a novel mechanism of quality control.

Robust or rubbish?

October's article *Trouble at the Lab* in *The Economist* starts with pointing out a problem of irreproducibility in priming experiments in the field of psychology and continues by stating that in less 'soft' fields of science this problem also began to gain attention. In cancer science for example, *Bayer HealthCare* and *Amgen*, both pharmaceutical giants, have shown that many landmark discoveries published in top journals don't hold up when replicated. Robust knowledge comprises that the same experiments should always generate the same results, so this problem of irreproducibility rumbled uncomfortably. But what process drives generating rubbish claims? According to the writer of the article, fraud is likely second to incompetence merely concerning statistics, but both processes are hugely exacerbated by poor peer-reviewing and the publish-or-perish way as an academic birthright rather than demonstrating talent. The pernicious effect of this *quantity over quality* credo catalyzes the publishing of uncorrected material and merely exists by virtue of trust. So why don't we start with less trusting and more verifying?

Although most research already partially consists of validation of key conclusions, a one-time-only approach for publishing promising results should definitely be suspicious. As scientists are mainly judged by numbers and citations, verification and replication of already existing results is deemed uncreative, dull and is not likely to be funded. Graduate students however, hardly face any funding pressure and could therefore provide a mechanism by which the recent scientific results of their superiors are being re-examined.

Verify, then trust

The practice of using the skills and critical mindset of graduate students for replicating existing work is not common. Although not always, most educational staff members encourage the students distilling clever approaches for expanding forefront knowledge. At the same time, too little attention is paid to the value of critically assessing experimental work of superiors.

To go back to the point of less trusting and more verifying, stated in the previous section, we should foster the cheeky attitude of graduate students as future scientists. In the name of proper science it is beneficial for critically assessing the epistemological status and honesty of the professor. To prevent rashly publishing of invalidated results due to too little quality control and replication, a small part of the funding that principal investigators receive for doing their research, should go to one or two students re-examining results. By determining a fixed percentage of the funding going to quality control by students, principal investigators already allow this to be part of the request. Why is this approach so disarmingly simple and effective?

First, when graduate students replicate already found results, it provides, to say it blunt, an inexpensive way for ensuring the first quality control of results. Mere replication of scientific results has shown not to be a successful approach for obtaining a grant, as taxpayers' money allows researchers to serve the public by providing new insights, instead of re-examining them. Because graduate students do not receive wages for doing experiments, a fixed percentage of the whole grant, say five percent, is a relatively cheap solution for verifying experiments. Funding of graduate students therefore does not infer payment of workload, but provides the expense of additional use of materials and devices needed for replication.

Second, this approach delivers both researchers and students with new insights of quality control and possibly disarms unjustified trust. The use of graduate students provides an extra mechanism of supervision and will therefore sharpen experimental work and analysis of resulting data. This approach will inherently lead to less creative work for graduate students, but for obtaining a master's degree most universities require the completion of more than one internship. Therefore, replication of experimental work may be limited to the first internship, resulting in enough time for doing '*less redundant work*' in

A proposal to reduce poor quality checking in scientific research by funding graduate students

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the second one. Although doing superfluous experiments, the graduate student inherently learns technical and analytical skills and gets used to the fact of validation and replication as a part of producing robust results.

Finally, this approach could possibly provide the establishment of new networks between investigators and graduates. The graduate student should not be under direct supervision of the researcher whose experiments he or she replicates, as discussion could lead to bias towards an agreement in conclusions. In practice, this means that the student replicates the experiments in an affiliated laboratory with connection to, but not under direct supervision of the principal investigator's laboratory. Thus, the student should be under the supervision of a researcher other than he or she will 'judge'. This results in broadening and compaction of the academical network of the graduate student: instead of one, the student has two superiors (broadening), and the experimental work of one of them will be reviewed more in-depth (compaction).

In conclusion, by involving graduate students for re-examination of supervisor's experimental work and data analysis, both parties get familiar with this novel mechanism of quality control. By involving both parties, both can contribute to a renewed way of doing robust scientific work with a 'verify, then trust' criterion. This approach shares the promise of tackling the existing problem of nonreplication, and prevents the same to happen in the future.

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The Economist article:

Anonymous (2013) Trouble at the lab. *The Economist* 409:23-27