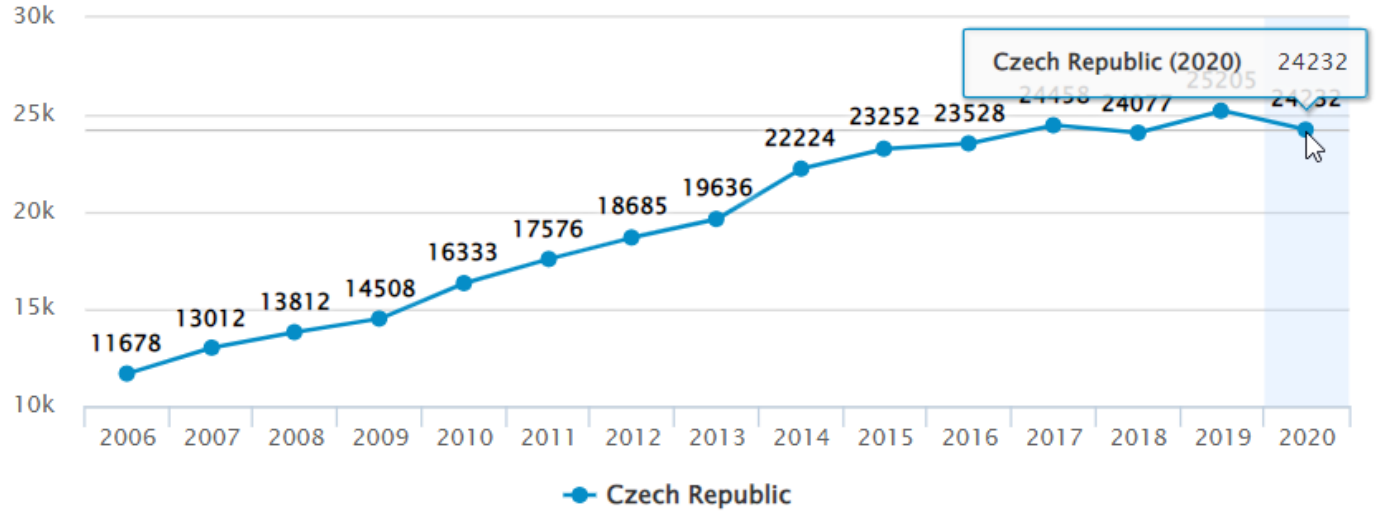
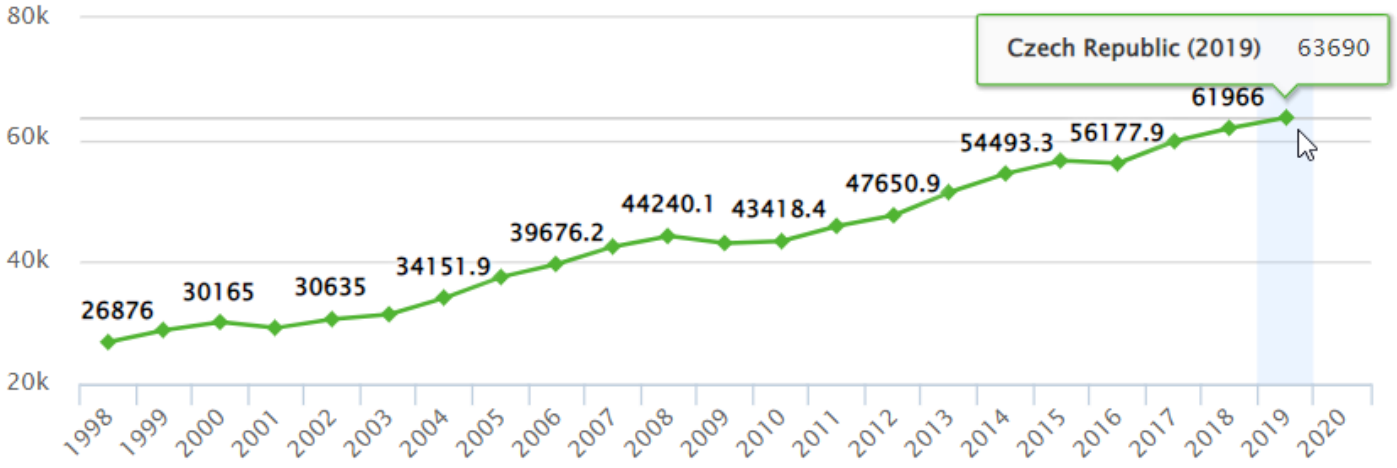
A few facts about Czech science

❍ Czech science has an annual output of 24,000 scientific publications (2020), which makes up approx. 4% of the US output (626,000 in 2020), with the total number of Czech researchers almost 64,000, and government expenditures on R&D 0.64% of the GDP in 2020 (OECD 2021).

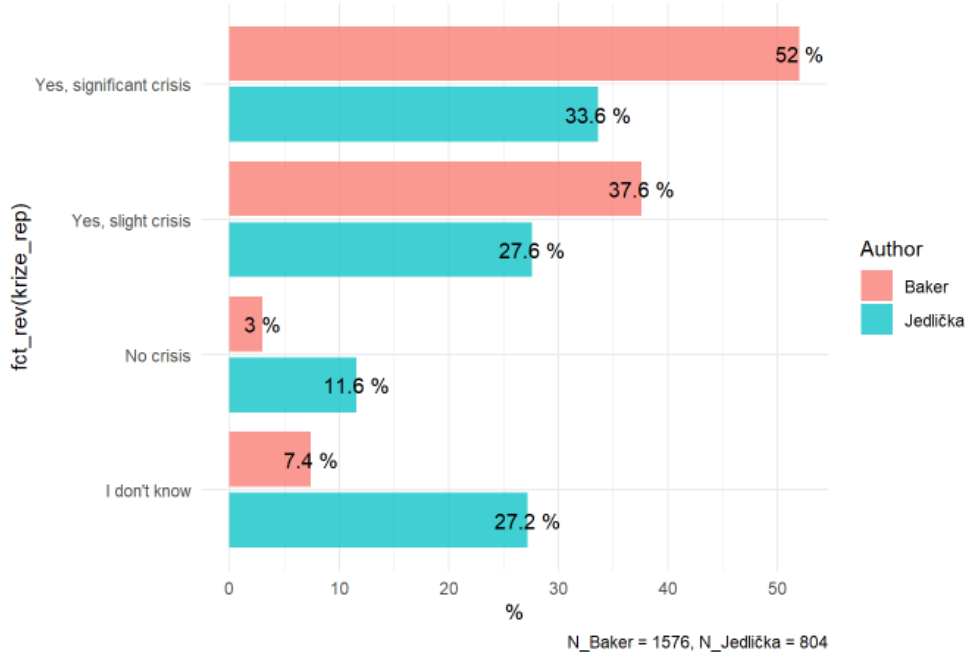




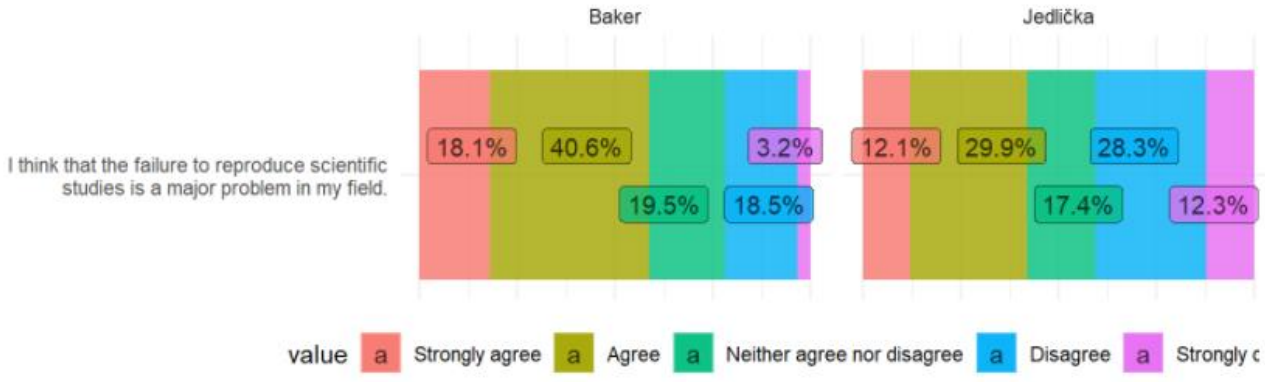
Main findings

1. Is there a reproducibility crisis?

❍ Our preliminary results from the leading Czech research institutions show that scientists are in general less concerned about the reproducibility crisis as only one third (33.6%) of them believe that there is a "significant" crisis as compared to slightly over half (52%) in the original Nature survey (Baker 2016). Also, the combined share of Czech scientists who think there is either a "significant" or "slight" crisis is only 61.2%, in contrast to 89.6% in the Nature survey. In total 11.6% of Czech scientists expressed the view that there is "no crisis" – four times more than in the original survey (3%). Some of these discrepancies (but not all) can be explained by the composition of the samples, e.g. frequency of the disciplines or demographical and academic characteristics.

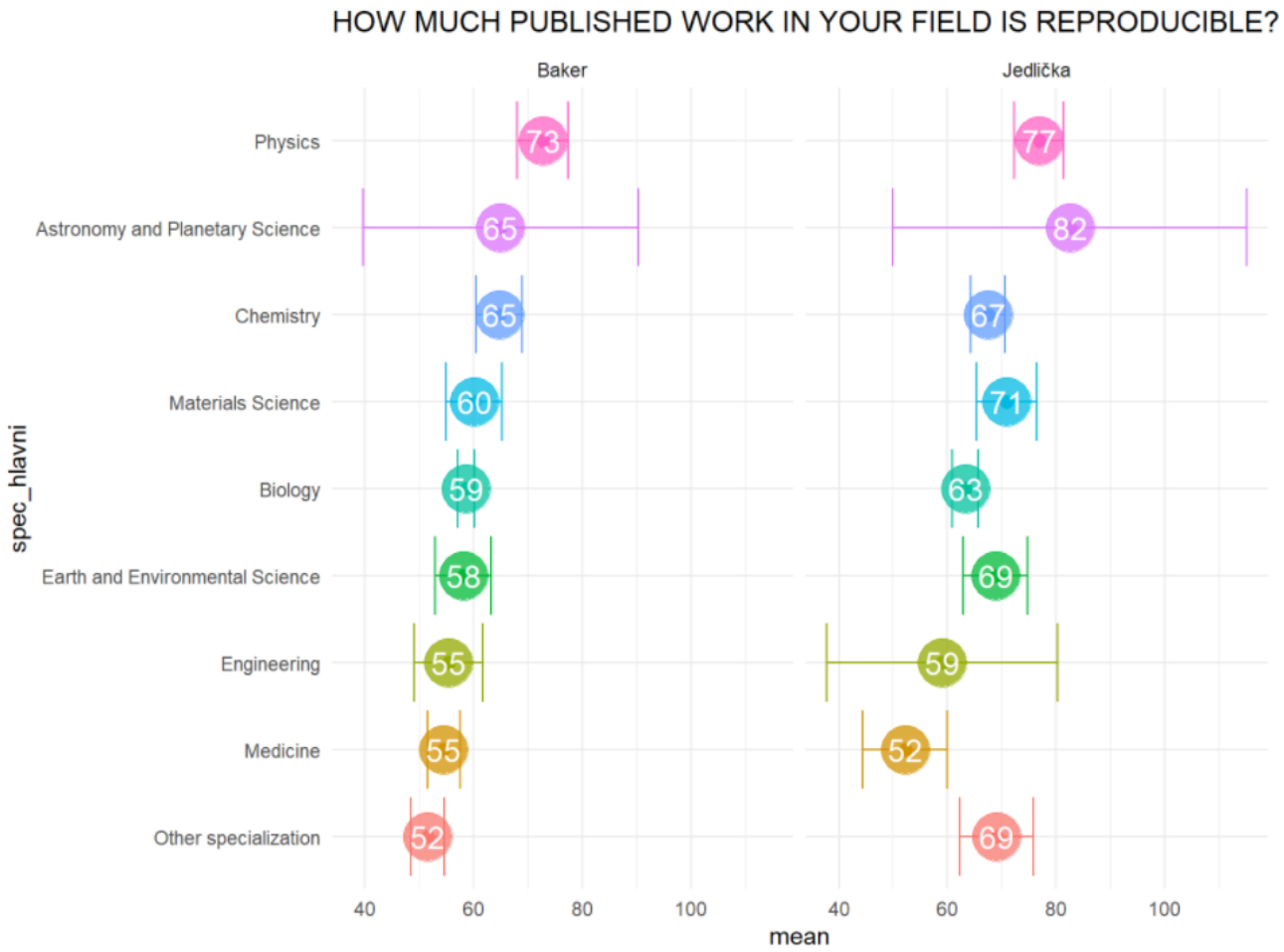


❍ Different perceptions of the urgency of reproducibility issues were confirmed by the answers to the following statement:



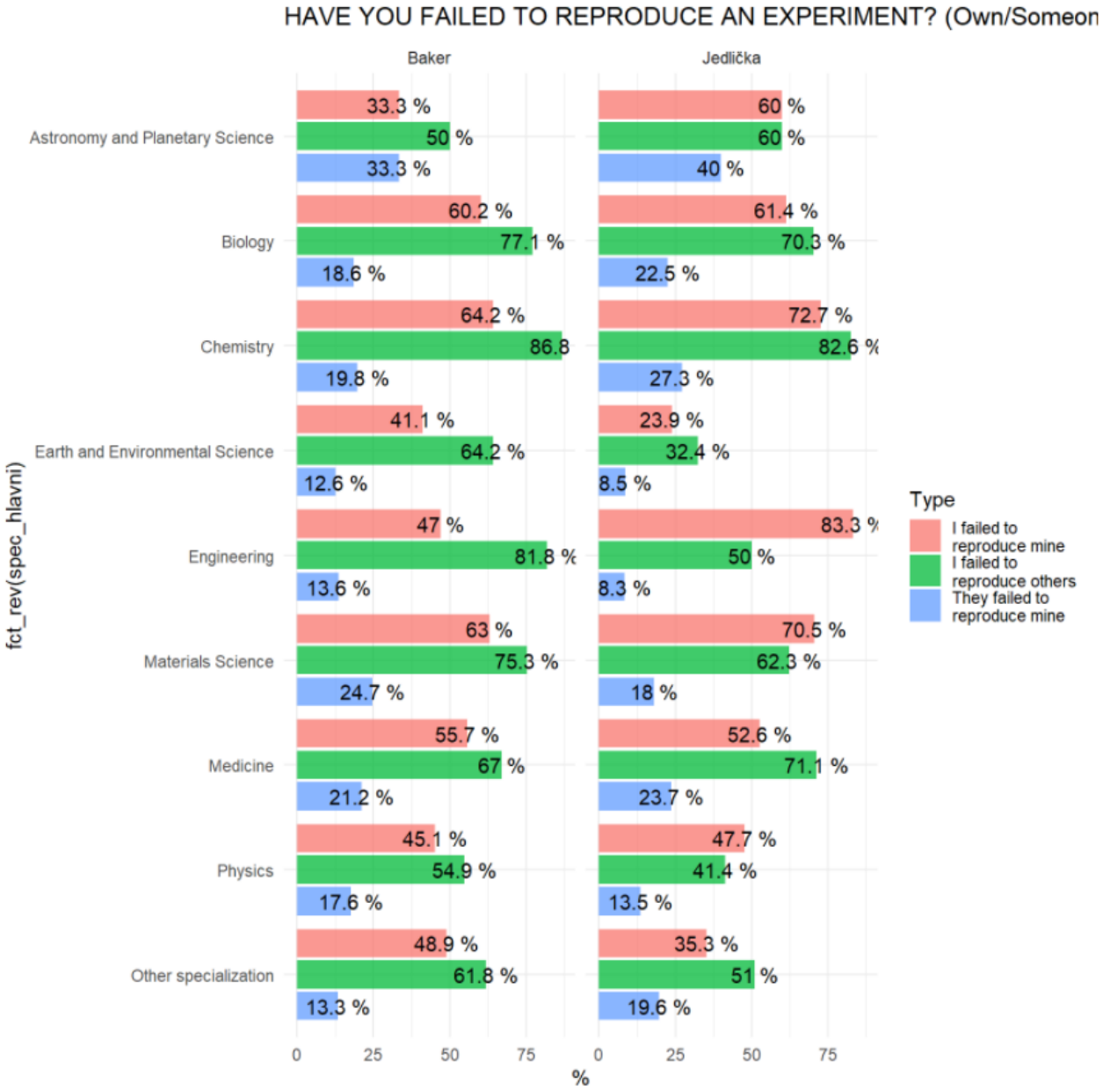
2. How much published work in your field is reproducible?

❍ The chart below shows averages and confidence intervals for each of the disciplines. In line with *Nature's* findings, Czech scientists, when assessing their own field, think that reproducibility is progressively higher in the more exact disciplines such as physics (77%) or chemistry (67%), but declines in biology (63%) or medicine (52%).



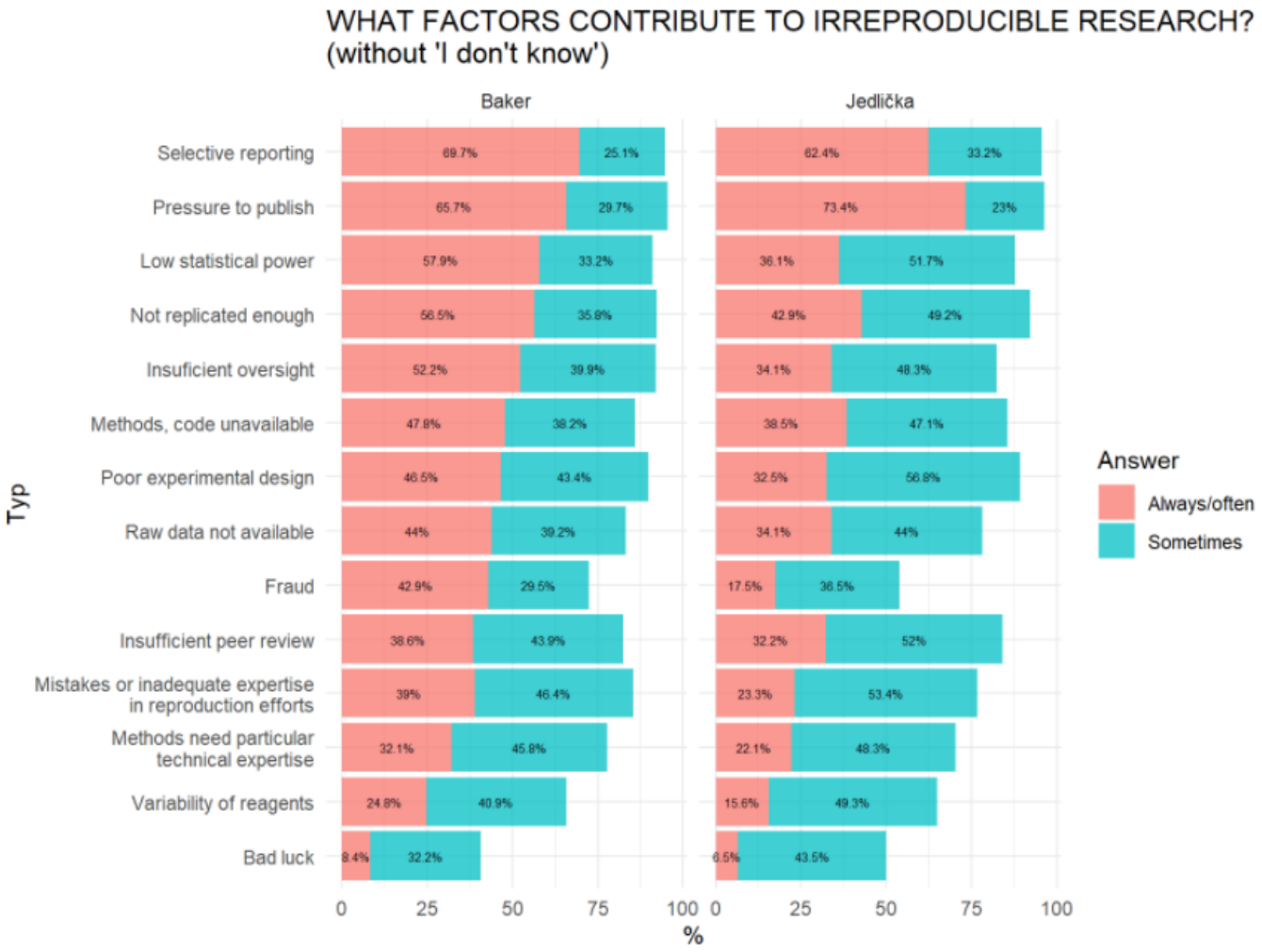
3. Have you failed to reproduce an experiment? (your own /someone else's)

Here, the results match quite closely in both surveys with one-digit differences for the main disciplines (physics, chemistry, biology, medicine). As expected, Czech physicists reported a substantially lower non-reproducibility of their own or someone else's experiments (47.7%, and 41.4% respectively), compared to biology (61.4 %, and 70.3 %), and medicine (52.6%, 71.1%), but somewhat surprisingly, chemists gave quite a high irreproducibility rate (72.7%, and 82.6%), which may be attributed to the sensitivity of the chemical experiments (purity of reagents etc.)



4. What factors contribute to irreproducible research?

❍ In general, Czech scientists are less resolute in attributing non-reproducibility to various factors as expressed by the share of the „Always“, „Very often“, or „Sometimes“ answers given to the various options. The most important factors contributing to non-reproducibility in Czech research institutions are „Pressure to publish for career advancement“ (96.4%), followed by „Selective reporting of results“ (95.6%), and „Original findings not robust enough because not replicated enough in the lab publishing the work“ (92.1%), and „Poor experimental design“ (89.3%), for which the results are also close to the original survey. Significantly fewer Czech scientists think that fraud is a major contributing factor to non-reproducibility (54%), compared to the original survey (72.4%).

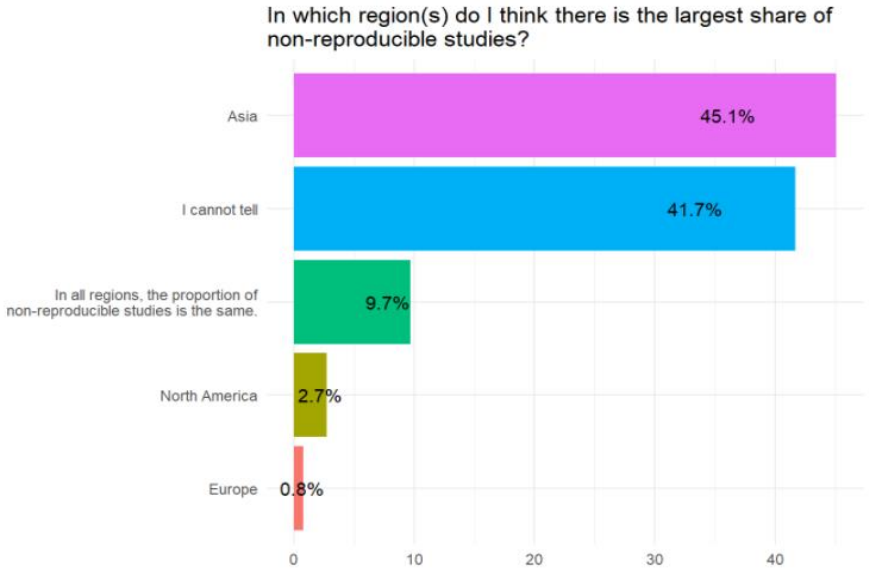


5. „Less Scientifically Developed Culture“ Effect

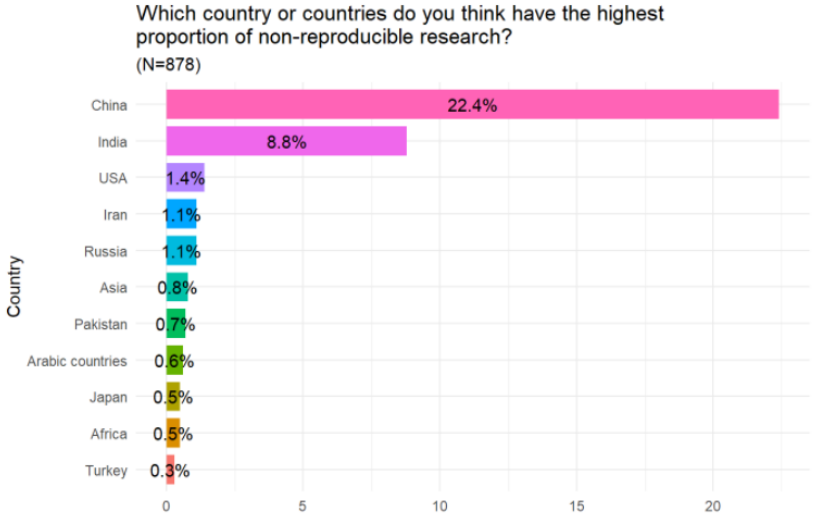
❍ Already in the qualitative research phase (individual interviews and focus groups with 41 natural scientists) we found that a substantial number of them link irreproducibility to the developmental phase of a scientific culture and suggested that this is unevenly geographically distributed across the world regions. We called this phenomenon the “Less Scientifically Developed Culture” effect.

❍ Scientists in our sample expressed a lack of confidence particularly in the quality of Asian (mostly Chinese, and Indian) science. Subsequently, we tested this hypothesis in the quantitative survey which confirmed these findings: 45.1% of the respondents reported that Asia produces the highest share of irreproducible research, as opposed to 9.7% who think there are no regional differences, or those who pointed to North America (2.7%), or Europe (0.8%).

❍ The underlying causes for the LSDC effect can be found in the quality and rigor of scientific work – scientists often consider research in these countries as having weaker methodological and publication standards – although they readily admitted in the interviews and open questions that there are also top-notch laboratories and institutes in these countries, which produce cutting-edge research in line with the best standards. One of the main reasons for the high incidence of non-reproducible research in these countries is often cited as publication pressures due to career advancement (Huang 2018). Regardless of the actual veracity of the claim of poor quality, this perception is evidently deeply rooted and has already created a discernible stereotype in the form of the LSDC effect, which has prompted scientists to adopt various protective and coping strategies.



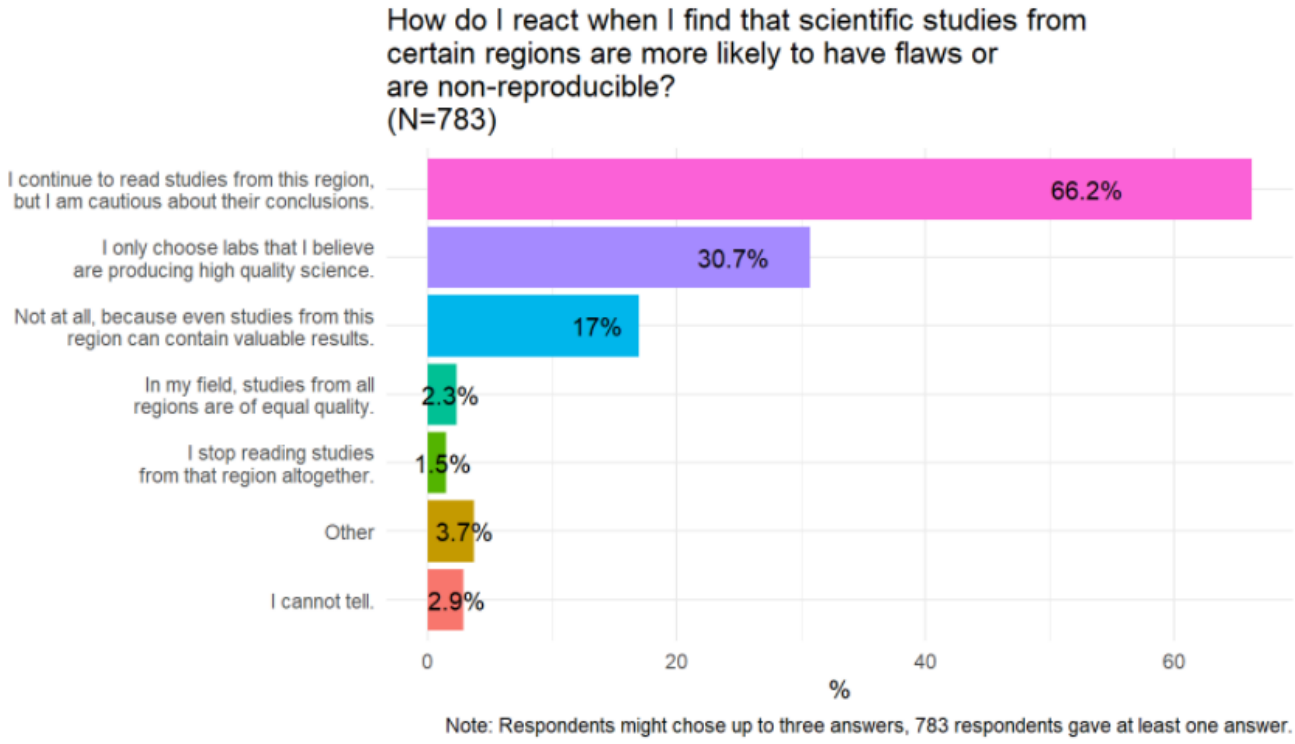
When asked in an open question about a particular country or region[1], scientists mostly named China (22.4%), and India (8.8%) as the main culprits, with USA (1.4%), Iran (1.1%), and Russia (1.1%) lagging in the far distance. The differences are especially salient when we take into account roughly comparable research outputs in China and the USA in recent years (Nature 2020, NSF 2020).



[1] Respondents could mention more than one country, in total 227 respondents gave 350 mentions (N=878).

6. How do I react when I find that scientific studies from certain regions are more likely to be flawed or non-reproducible?

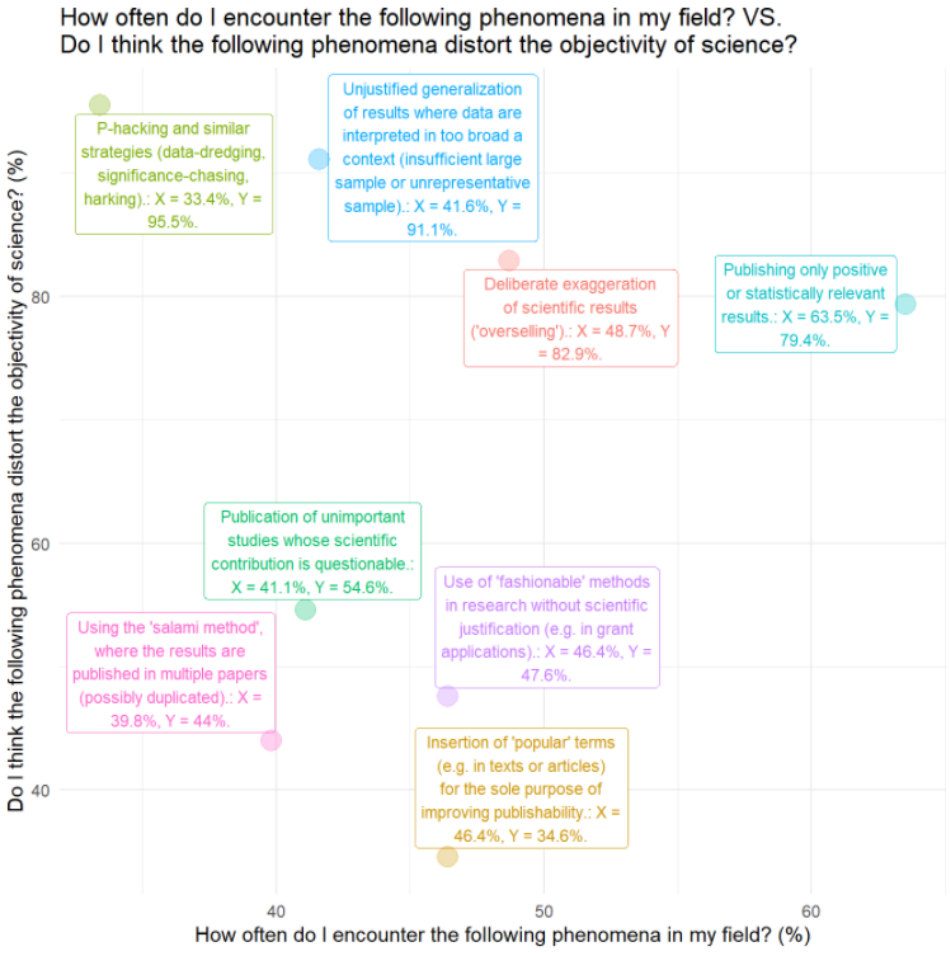
❍ Based on previous findings we also inquired how scientists react when they find out that papers from certain regions are more likely flawed or are non-reproducible. The prevailing coping strategy is that they continue to read studies from this region, but are at the same time cautious about their conclusions (66.2%), or they only choose laboratories or institutes that they believe are producing high quality science (30.7%). Only a small number (2.3%) stated that they stop reading studies from this region altogether.



7. Other Questionable Research Practices (QRPs)

❍ In our qualitative research, we identified some other QRPs which we have a detrimental effect on the quality of science. In the following survey, we had scientists evaluate the extent to which they distort the objectivity of science (broadly defined), such as: Deliberate exaggeration of scientific achievements, Using the "salami method", where the results are published in multiple papers (possibly duplicated), Insertion of "popular" terms (e.g. in texts or articles) for the sole purpose of improving publishability, Deliberate exaggeration of scientific results ("overselling"), Publishing only positive or statistically relevant results, Unjustified generalization of results where data are interpreted in too broad a context (insufficiently large sample or unrepresentative sample), P-hacking and similar strategies (data-dredging, significance-chasing, harking), Use of "fashionable" methods in research without scientific justification (e.g. in grant applications).

❍ The scientists mainly complained about various abuses of statistics which they consider quite harmful to scientific objectivity (80% and more), although their incidences vary. Less damaging (below 60%) but also widespread are practices which are used to enhance the publication output, chances to get published and to get funding. The results are shown in the following chart:



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