GLOBAL YOUNG ACADEMY

Young Scientist Perspectives on Replicability and Reproducibility in Science and Engineering

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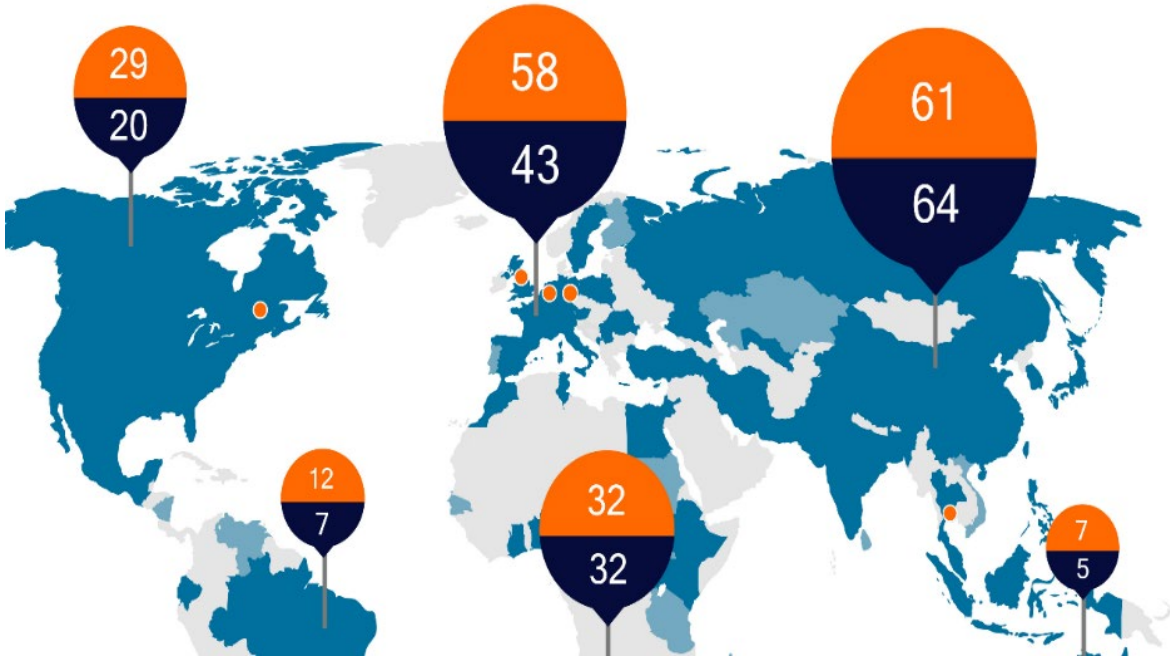
Who we are: The Global Young Academy

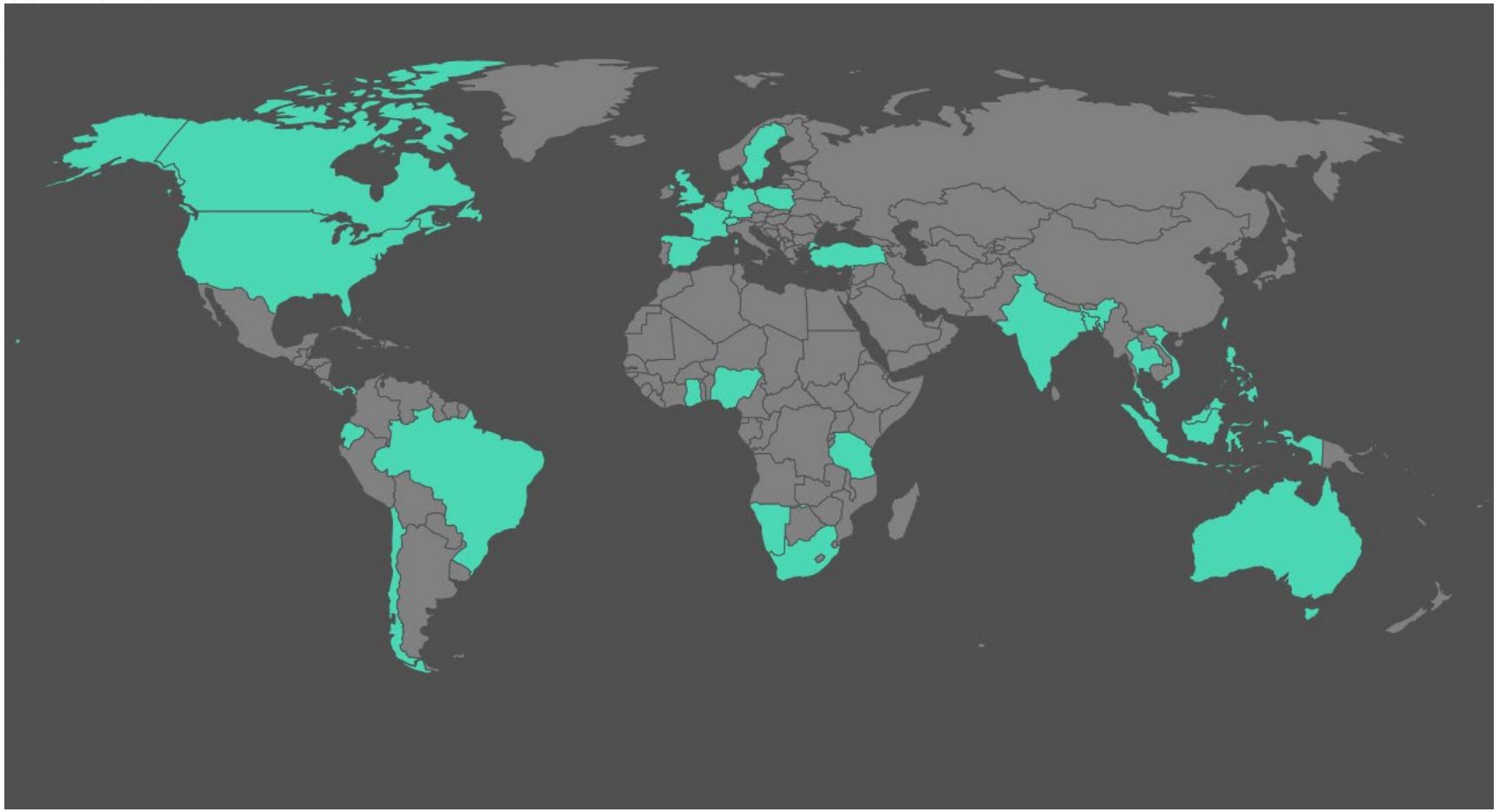
- A worldwide network of 200 members and 216 alumni from 83 countries.

- Selection criteria
  - Research excellence
  - Service and outreach

- Median age ~39y
- 5y membership term



This statement is based on our expertise and view of 50+ researchers questioned



There are issues with reproducibility and replicability, but consider these caveats…

- A lack of reproducibility/replicability is not always bad
- The reproducibility/replicability problem is not an isolated problem
- Direct reproduction/replication is rare, but often results are confirmed indirectly

Are there specific examples in your country/region where a lack of reproducibility and replicability in research results has led to doubt about reported results more broadly?

- Extreme cases of fraud (rare but toxic)

  (e.g. Schön scandal on semi-conductor research)
- Intentional or unintentional misconduct

  (e.g. incorrect use of statistics, important details omitted from methods)
- Systemic problems with research ecosystem

  (e.g. lack of incentives to publish replications studies, lack of incentives to publish null results, requirement to publish to get money, journal limitations on word counts)

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Responses suggest that public doubt about science comes from other problems with the science-media *interface*. For example…

- Research results are exaggerated or misrepresented in the media
- Provisional results are reported as conclusive
- Public disagreement between scientists is perceived as damaging rather than alternative interpretations of data
- Science is appropriated by politics, and this generates even more suspicion

Are reproducibility and replication of research results a global concern or is it a concern focused within specific countries?

- The consensus was global, with limited regional variation
- One caveat: in LMIC countries, lack of resources may lead to less control of potential variables
- There is a perceived difference, not so much between regions, but between national and international publications.
  - Local publications: concern about replicability due to potential lack of control/peer review
  - International publications: concern that increased competition creates wrong incentives

Are there particular scientific fields in which lack of reproducibility and replicability is more/less of a concern?

- Psychology and medicine called out as being more of a concern
- Engineering and physics called out as being less of a concern
- In some fields, reproducibility and replicability is more difficult to achieve

  (e.g. qualitative studies, field research in which environmental factors are not easily controlled, problems applying findings from the lab in practice)

Examples of actions taken to address concerns about reproducibility and replicability

- Revising publishing procedures and requirements (various European countries have made progress here)
  - requirement to publish raw data
  - requirement to demonstrate reproducibility by showing replicates
  - requirement to publish complete experimental procedures; away from "Online Methods" and online only content
  - more possibilities to publish "negative" and "confirmatory" data
- Skills training on statistical data analysis
- Funders demand specific description of methodology and of statistical analysis (Panama)
- Ethical control (ethical committees in Romania and Turkey) or research ethics training (in Malaysia)

Should the research community work regionally and/or globally to address concerns about reproducibility and replicability?

- Standards should be set globally
- Regional action necessary for easier and more specific implementation

But note: <u>one size doesn't fit all</u>, and this is not necessarily related to regional differences.

Recommendations, *basic principles*

- Don’t put the burden on (young) researchers
- Don’t discourage researchers from taking risks and exploring the unknown
- Think about cost/gain
- The robustness of science is not correctly measured by assessing replications of individual contributions

We see the reproducibility problem as…

- A communication issue (inside science and with the broader public)
- A time issue
- A methodology and training issue
- A problem with the current publication culture
- A problem with the current scientific ecosystem at large

Thank You!