Reproducibility in functional MRI: validation, improvement and future

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Symposium
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Recently, researchers have started to validate the reproducibility of fMRI studies with real data, which revealed a discomforting picture. Although fMRI measures attained moderate reliabilities, they replicated poorly in distinct datasets, especially in small sample size studies. Practice of fMRI studies, including design, sample size, analysis/workflow should be improved. We will present our work towards the improved practice in this symposium.

Objective

1) Reproducibility of resting state fMRI studies on the impact of different strategies for multiple comparison correction; 2) Common statistical pitfalls and their solutions; 3) Methods and best-practices to improve the reproducibility of an fMRI analysis/workflow; 4) Address the difficulties in reproducing interactions with graphic user interfaces to neuroimaging software with web-based tools.

Target Audience

Resting-state and task fMRI researchers who are interested in reproducibility of neuroimaging.

Co Organizer(s)

Krzysztof Gorgolewski, Stanford University
Anisha Keshavan, University of Washington
Jean-Baptiste Poline, McGill University and University of California at Berkeley

Organizer

Chao-Gan Yan, Institute of Psychology, Chinese Academy of Sciences

Presentations

Reproducibility of R-fMRI metrics on the impact of different strategies for multiple comparison correction and sample sizes (index.cfm?do=ev.viewEv&ev=1685)

Concerns regarding reproducibility of R-fMRI findings have been raised. We comprehensively assessed two aspects of reproducibility, test-retest reliability and replicability, on widely used R-fMRI metrics in both between-subject contrasts of sex differences and within-subject comparisons of eyes-open and eyes-closed (EOEC) conditions. We noted permutation test with Threshold-Free Cluster Enhancement (TFCE), a strict multiple comparison correction strategy, reached the best balance between family-wise error rate (under 5%) and test-retest reliability/replicability. Although R-fMRI indices attained moderate reliabilities, they replicated poorly in distinct datasets (replicability < 0.3 for between-subject sex differences, < 0.5 for within-subject EOEC differences). Small sample sizes (e.g., < 80 (40 per group)) not only minimized power (sensitivity < 2%), but also decreased the likelihood that significant results reflect “true” effects (PPV < 0.26) in sex differences. To answer the call of large sample sizes to improve reproducibility, we launched a collaborative initiative (The R-fMRI Maps Project) to build a data-sharing global network. With this network, we cumulated the largest depression R-fMRI database (REST-meta-MDD: 1300 MDD vs. 1128 NC) in the world, and found reproducible abnormal activities in patients with depression.

Presenter

Chao-Gan Yan, Institute of Psychology, Chinese Academy of Sciences

Reproducibility and replicability: a practical approach (index.cfm?do=ev.viewEv&ev=1686)

In recent years many concerns have been raised about the validity of results reported in the psychological literature. Among many suggestions intended to improve the situation, there were calls for improved reproducibility of reported experiments as well as more replication studies. However, these suggestions are not trivial to implement. Increasing reproducibility of your analysis can be time-consuming and technically challenging. Replication studies are often difficult to interpret and publish. In this talk, I will discuss some practical solutions to increase reproducibility of data analysis and make replication studies more common.

Presenter

Krzysztof Gorgolewski, Stanford University

The problems associated with the use of p-values in brain imaging and their effects on reproducibility (index.cfm?do=ev.viewEv&ev=1687)

Since the seminal work of Ioannidis et al (2005) a number of works have shown issues with the predominant use of the p-value measure as a filter for publication of results. In this talk, I will first briefly review the classical issues of the use of p-values, including associated effect size and power. I will describe how the use of the p-values can lead to p-hacking, as well as the statistical and social tools (p-curve, pre-registration) available for correcting this issue and how this may affect the analysis of shared data. I will present some credible alternative in the Bayesian framework and a path to adopt these in the brain imaging community.

Presenter

Jean-Baptiste Poline, McGill University and University of California at Berkeley

Web-based neuroimaging tools for reproducible and collaborative research (index.cfm?do=ev.viewEv&ev=1688)

While recent adoption of software engineering practices have helped address reproducibility concerns in fMRI research, there exists a substantial amount of manual intervention in scientific research that is difficult to reproduce. Traditional graphical user interfaces (GUIs) to scientific software often do not record the exact series of manual steps taken to perform an analysis. On the other hand, web-based user interfaces have the ability to record and store all user interactions to a centralized database. An added advantage of web-based tools is that the browser provides the means to efficiently communicate and collaborate on scientific research. In this talk, I will present a range of web-based neuroimaging tools to enable researchers to perform reproducible and collaborative research, and discuss the strengths and weaknesses of web-based GUIs.

Presenter

Anisha Keshavan, University of Washington