# Reproducibility and the conduct of research



Data dredging Also known as p-hacking, this involves repeatedly searching a dataset or trying alternative analyses until a 'significant' result is found.



**Errors** Technical errors may exist within a study, such as misidentified reagents or computational errors.



results When scientists or iournals decide not to publish studies unless results are statistically significant.



methods A study may be very robust, but its methods not shared with other scientists in enough detail, so others cannot precisely replicate it.

Underspecified



Underpowered study Statistical power is the ability of an analysis to detect an effect, if the effect exists - an underpowered study is too small to reliably indicate whether or not an effect exists.



Weak experimental design A study may have one or more methodological flaws that mean it is unlikely to produce reliable or valid results.

Improving reproducibility will ensure that research is as efficient and productive as possible. This figure summarises aspects of the conduct of research that can cause irreproducible results, and potential strategies for counteracting poor practice in these areas. Overarching factors can further contribute to the causes of irreproducibility, but can also drive the implementation of specific measures to address these causes. The culture and environment in which research takes place is an important 'top-down' overarching factor. From a 'bottom-up' perspective, continuing education and training for researchers can raise awareness and disseminate good practice.

Figure taken from the report of the symposium, 'Reproducibility and reliability of biomedical research', organised by the Academy of Medical Sciences, BBSRC, MRC and Wellcome Trust in April 2015. The full report is available from http://www.acmedsci.ac.uk/ researchreproducibility.

# Possible strategies





## **Pre-registration**

Publicly registering the protocol before a study is conducted.



Collaboration Working with other research groups, both formally and informally.



### Automation

Finding technological ways of standardising practices, thereby reducing the opportunity for human error.



**Open methods** Publicly publishing the detail of a study protocol.

#### **Post-publication review**

Continuing discussion of a study in a public forum after it has been published (most are reviewed before publication).



#### **Reporting guidelines**

Guidelines and checklists that help researchers meet certain criteria when publishing studies.

