

In an ideal world, the data (white points) is **collected and reported in an unbiased way**, and in aggregate it correctly represents the underlying (true, Θ_0) effect size (ES) of the studied quantity, as well as its sampling variability.

More precise estimates tend to cluster closer to the true effect size (ES), but on average Θ_0 **gives the unbiased idea about the strength of the measured ES** - even if **some studies, by chance, fall close to zero** or indicate a sing-reversed ES.

NULL (ZERO) EFFECT SIZE

TRUE EFFECT SIZE Θ_0

Publication bias selectively **prevents small ES/non-significant ES** from being published.

This results in **overestimated overall effect size Θ_1** , and distorted view of the field.

Power analysis based on the assumption that true ES = Θ_1 will suggest required sample sizes far too low to detect the actual, biologically realistic Θ_0 .

In an attempt to **please the ethical committee boards by minimising the numbers of experimental animals, or to reduce costs** by reducing sample size, one may do power calculation with the most extreme form of bias - **only referring to the strongest reported effect sizes**.

Power calculations performed in such way will almost certainly suggest sample sizes unable to recover the (much weaker) true biological effect size.

Estimates from such underpowered studies will (mostly) be **too small & nonsignificant** OR **(by chance) overestimated**



forgotten as not "sexy" enough



published as ground-breaking and revolutionary, further biasing the perceived ES

The Vicious Cycle of Power Analysis & Publication Bias

Solutions?

Researchers

Replicate other studies, especially in different contexts (**heterogenisation**)

Publish (or make discoverable) all your results, including reports of weak/non-significant ES

Pre-register your studies to avoid QRPs

Publishers

Provide **space to report non-significant** results

Discourage authors and reviewers from **relying too much on p-values**

Funding agencies

Remove power sample size analysis from grant application guidelines

Promote the **AHARP** approach: sample size should be As High As Practically Reasonable

Drunk with power. The ambiguous use of statistical power analysis in research

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