Biological and Technical Replicates – NIH Experimental Design and Reproducibility Module #3

Potential Discussion Points and Questions:

Starting Points:

- Replication: requires a precise process where the exact same findings are reexamined in the same way with identical design, power, subject selection requirements, and level of significance as the original research study.[1]
- Biological replicates are parallel measurements of biologically distinct samples that capture random biological variation, which may itself be a subject of study or a source of noise.
- Technical replicates are repeated measurements of the same sample that represent independent measures of the random noise associated with protocols or equipment.[2]

Lead-in Questions:

- Within an individual experiment, what do you think is the best approach to determine the appropriate number of replicates?
- How did you learn about the need for replicates and the difference between certain types of replicates?

Follow-up Questions:

- Do you think it is common to report data from a single experiment (technical replicates) to generate an "exciting" finding? How often is this type of practice viewed as a way to expedite the research process?
- Since this is a grant application with preliminary results, is it acceptable to include results in such a manner?
- Is it appropriate for the applicant to purposely leave information about the type of replicates out and plot the data in such a way to suggest significance over multiple experiments? Can it be considered falsification and therefore possible misconduct? If so, what are the potential consequences? What if it was simply an oversight?
- If this was your grant application, how would you have portrayed the data? Would you clearly state the "n" in the figure legend and/or describe this in the body of the grant? Would you have indicated the exclusion of data?
- Do you think papers or grant applications should delineate the use of biological vs. technical replicates in the figure legends (or elsewhere in the document)?
- The reviewer provides an analogy of "taking a thousand cells from one animal" and getting "just one point" from the resulting data. Is this always the case?[3]
- Do you think the review of the project will be affected?

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[1] http://grants.nih.gov/grants/guide/pa-files/PAR-13-383.html

[2] http://www.nature.com/nmeth/journal/v11/n9/full/nmeth.3091.html

[3] Aarts, E et al. A solution to dependency: using multilevel analysis to accommodate nested data. *Nature Neuroscience*. 2014 April; 17(4): 491-496. http://www.nature.com/neuro/journal/v17/n4/full/nn.3648.html

- Do you think a typical review session discussing this issue would be as collegial?
- The reviewers appeared to be convinced easily that the figure was misleading. Do you think this transition in thought would have been so quick and painless if it were a real review session?