This is a draft commentary on “Making replication mainstream” (Zwaan, Etz, Lucas, & Donnellan), *Behavioral and Brain Sciences*.

Introducing a replication-first rule for PhD projects

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Abstract: Zwaan et al. mention that young researchers should conduct replications as a small part of their portfolio. We extend this proposal and suggest that conducting and reporting replications should become an integral part of PhD projects and be taken into account in their assessment. We discuss how this would help not only scientific advancement, but also PhD candidates’ careers.

Commenting on the role that replications should play in a researcher’s career, Zwaan et al. briefly suggest that early career researchers should conduct replications “with the goal of building on a finding or as only one small part of their portfolio”. Extending this, we propose that conducting and reporting replications should become an integral part of PhD projects and should be taken into account in their assessment. Specifically, we suggest adopting a *replication-first* rule, whereby PhD candidates are expected to first conduct a replication when they are building on a previous finding, and only then collect data in their novel study.

One reason we consider it important to specifically address the role of replications for early career researchers is that they face enormous pressure to establish themselves in the scientific community and often fear that their careers could end before they really begin (Maher & Anfres, 2016; “Many junior scientists”, 2017). Currently, in order to secure a job in academia after obtaining a doctoral degree, one needs to build an impressive portfolio of publications (Lawrence 2003). Based on our observations of how research projects are carried out in practice, PhD candidates often directly attempt innovative extensions of previous experimental work in the hope of answering a novel research question, since novelty strongly increases publishability (Nosek, Spies & Motyl 2012). When such extensions fail to produce the expected results, they tend to collect more data in several variations of their own experiments before turning to examine the replicability of the original effect. However, it may oftentimes turn out that they cannot reproduce the original finding, possibly because the original effect is, in fact, not robust. In these cases, replicating the original effect first would prevent what may turn out to be a substantial waste of time and resources on follow-up experiments. Moreover, the time saved due to replicating first can be used to further examine the robustness of the original effect, for

instance by conducting an additional high-powered replication. Such replications contribute to a better estimate of effect sizes which are currently often overestimated due to publication bias, sampling error, or p-hacking (Fanelli 2011; Ferguson & Brannick 2012; Szucs & Ioannidis, 2017). As such, replications constitute an important scientific contribution and should be regarded as such by PhD project advisors.

The above arguments demonstrate advantages of replicating first in the case of a failed replication. Likewise, successful replications provide a great opportunity. Pressure to publish operating simultaneously with the publication bias means that early career researchers are currently pressed to obtain specifically *positive* findings to publish papers. As a result, in our experience, not knowing whether an experiment will yield positive results causes anxiety in PhD candidates. Incorporating replications as a first step of any new research project can help alleviate this anxiety. If an extension shows no effect or supports the null hypothesis after a successful replication of the original effect, it should be easier to interpret the theoretical significance of this outcome. For instance, suppose that one replicates a previously-observed priming effect but does not obtain it when the primes are masked. In this case, one can directly compare the effect in both conditions and make a convincing case about the role of visibility for the effect. These two experiments can likely be put together in a strong paper. Similarly, a successful replication and extension makes for a solid package that will convince PhD candidates themselves and the fellow researchers who read their work. This way, replicating first shifts the focus from the *results* to the *underlying scientific process* (how well the work is carried out). In combination with the registered reports format (Chambers 2013), we believe a replication-first rule would minimize PhD candidates' stress caused by the anticipation of negative results and increase the quality of their work.

Finally, we hope that adopting the proposed replication-first rule would bring an important shift in the necessity for early career researchers to learn and demonstrate the ability to conduct replications appropriately. Specifically, evaluating the outcome of replications often involves assessing the strength of accumulated evidence using state-of-the-art meta-analytic tools. We hope demonstration of such skills will be taken increasingly into account in quality assessment of theses, and in hiring decisions. Widespread application of the replication-first would also generate pressure on graduate schools to organize corresponding courses and seminars.

Even though adopting the replication-first rule may be difficult in cases where data collection is costly for the budget or available resources of a PhD-project, this should not be seen as a sufficient reason to omit replications as also pointed out by Zwaan et al. Since such studies often have smaller sample sizes and more room for arbitrary data analysis choices, replicability is an even larger issue for them (see Poldrack et al. 2017 for a discussion of this for fMRI findings). The growing awareness of this state of affairs in the field will likely lead to greater appreciation and higher rewards for replication in these cases. PhD candidates are thus well-advised to go the extra mile and replicate first. If two separate experiments are not feasible, incorporating a replication in the novel study design would be an option.

In sum, we believe that adopting the replication-first rule for PhD projects would not only contribute to scientific progress in the way Zwaan et al. lay out, but would also be beneficial for the PhD candidates themselves. We predict that this will result in a larger number of solid findings and publishable papers, as well as incentivize PhDs to master the necessary meta-analytic statistical tools for assessing evidence in cumulative science. This way, we believe conducting replications could be a great boost for early researchers' careers rather than only a "service to the field". That said, we of course do not suggest obliterating the value of creativity and original thinking in doctoral theses and their assessment. The replication-first rule is intended as a constant reminder that a balance between the two is needed for ensuring solid science.

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