Short nature comment paper…

The current state of reproducibility from a graduate prospective

*Anthony Davidson* and *Jill Barrett*

In this short comment is from the position of a graduate student to one aspect of current scientific environment we work in…

*Dear Editor,*

*I hope to shine light on a small but monumentally painful step that adds resistance to the scientific progression more than the scientific community may be aware. Hits from the literature. In particular, over the past decade the building of workflows/systems are more computational and mathematical have also increased hugely (Figure 1)*

*Regards,*

*Anthony*

##### Comment on graduate student satisfaction surveys.

The recently released Nature survey on the satisfaction of graduate students indicate both high levels of satisfaction and high rates of mental health struggles. Given these dual, almost conflicting findings, we sought to consider briefly, what it is within a PhD that creates such anxiety development? Graduate research, as recognised in the survey and more widely (cite) allows committed individuals to work on the creative, cutting edge of science. To undertake this work, students develop and apply knowledge to a range of complex, exciting research areas. In almost all of this research, there is a strong and increasing dependency on numbers and statistical analyses. The anxiety and stress experienced by both undergraduate and graduate students when dealing with statistics has been documented (cite). Given the increase in statistical analyses expectations, increases in the size and reliance on tools for undertaking these analyses and larger data sets able to be both collected and analysed using increased computational powers and statistical tools, it stands to reason that the application and reliance on numbers may be contributing to increasing anxiety in graduate students. Solution to the numbers game – providing statistical support to lower numbers anxiety

## Extended for PNAs

### Progression of Science

**Comment on graduate student satisfaction surveys**

* Late last year, Nature released their bi-annual survey on the satisfaction of graduate students(“2019 Graduate Outcomes Survey” 2019). Generally, this research indicated both high levels of satisfaction and high rates of mental health struggles which was no suprise since the previous survey’s suggested teh same conclusions (Woolston 2017).
* Simultaneously, graduate research, is recognised in the survey and more widely (cite) as allowing committed individuals to work on the creative, cutting edge of science.
* And increasing numbers (2007 to now…)
* To undertake this work, graduates develop and apply knowledge to a range of complex, exciting research areas.
* Under these conditions graduate students also un-intentionally put themselves and colleagues under huge levels of stress. And battling mental health challenges
  + Crazy increase…. maybe not unis faults 29% of 5700 now 86% of 6300 (Woolston 2017, 2019)
  + But committed (Woolston 2017)
* And it appears to be very important…What about the reproducibility crisis? (Baker 2016; Peng 2015)

#plot the proposed relationship?  
  
#computational complexity vs graduate mental health outcomes.  
#just the plot....

**Statistical environment**

The anxiety and stress associated with statistical classes and research projects experienced by the greater research community (cite) is prolific and possibly more for tertiary students (undergraduate and graduate students (cite)).

Given the increase in statistical analyses expectations, increases in the size and reliance on tools for undertaking these analyses and larger data sets able to be both collected and analysed using increased computational powers and statistical tools, it stands to reason that the application and reliance on numbers may be contributing to increasing anxiety in graduate students.

The worse bit is that even if you can find additional work unis put so nuc time pressure on students that we are often working all night on pur work and days working on preforming for the supervisors or other opportunities that are needed to be taken to get the graduate positions over other students.

* Mental difficulty of work (simple stuff is done??)
* Social lack of support (science crissi and America)
* Financial Grants going down +++
* Future … poor from above but worse

Added for fun… (unis need to stop creating problems)

* Work pressure….
* Bad mental environmental status =
* nurtures fear
  + Science
  + From ecology
  + Jobs\*\*
* National and global issue
* So where are the role models work so hard for nothing mostly
* Have to catch up with the reproducibly crisis career..
* Stability and mental health Mentors and guidance
* that produce the novel finds of their work with little acknowledgement.
* But more commonly in todays scientific environment, graduates work on processes that are developed within technology and the concept of application leads to theory becomes hinged around reproducibility (cite??)

**Reproducibility**

* Many reproducible workflows are in development still
* It is these novel workflows and the computational pipelines behind them that could be the for reproducible science need to be documented and recorded (meta-data) (cite??).
* If done correctly, these computational pipelines become the backbone to test processes, and create the building blocks of future computations in unison with the progression of humanity and computational developments.
* it is a daunting process, even for experienced researchers (cite)
* Terminology is even complex (cite)
* everyone knows it but as a collection it is a mess
* Now this work is not repeatable
* namely, a scientific crisis maybe (Baker, M., & Penny, D. (2016); Hunter, P. (2017); Peng, R. (2015); Hunter, P. (2017))
* simply because we cant reproduce it.
* But throughout the uptake of these methods.
  + **Nature paper**
  + Meta analysis of key journals and the reoccurrence of reproducible keywords…
* tidyverse and extention to things that used to be ideals are now standard
* Still not working and reproducing science

**A super anxiety storm**

* The combination of the reproducibiliy crisis, the graduate crisis and the numerical crisis…..
* This could be as simple as using a computer to send emails and the processes and complex tools researchers apply and build to gain insight from the raw data they collect.
* The root of this problem could be associated with the additional increased dependency on numbers. The anxiety and stress in undergrads and graduates experience when studying statistics (Decesare, M. (2007). Couzens et al. (2015); Kendall, L. (2016))
* Historically, this is the maths and statistics applied to datasets collected intentionally for research questions, usually using a set of generic statistical methods and programs (e.g SPSS, Matlab and others)
* This is now no longer the case with the need for full “computational reproducibility” (elephant in in the room paper)

**Solutions**

Solution to the numbers game – providing statistical support to lower numbers anxiety

* The simple solution that universities can implement to nurture holistic support for their most vulnerable students.
* I propose the simple statistical/analytic support drop-ins and relaxed environments provide a environment that can actually provide the foundations to make change.
* After being heavily under funded at the university of canberra between 2017-2019…
* I also attach a simple methodological workflow that I would like to create a global discussion about as we have the tools as scientists to do so.
* that creates a “minimum” computational reproducibility baseline using free and open-access tools.
* Allow for support
* Dont worry if adding work = better solutions for the world
* BUT dont add more hours to work in a day
* lie about how much work we have to do in policy
* pay us for time lost and costs to things like childcare.
* prividge is to be worked at the individual level not population level.

JUST PUT THE GRAD STUDENTS IN POSITIONS TO MAKE IT HAPPEN!!!

#process diagram of key steps all free  
library(diagrammR)  
library(tidyverse)

## References

#### Reproducibility

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