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Teaching Reproducible Research: Brief report on a DART-P workshop

Over the last few years, concerns about the reproducibility of research findings has prompted re-examination of 'questionable research practices' commonplace in traditional psychological science. Consequently, the way that researchers conduct, analyse, and report psychological findings is changing.

This so called 'reproducibility crisis' is a serious challenge to psychology education. It influences the credibility of the psychological knowledge acquired by our students. It also has implications for the teaching of quantitative research methods. Yet, formal curricula are slow to react. A further complication is that many psychology educators are less familiar with recent methodological developments, having been trained according to the traditional paradigm. Consequently, the DART-P committee selected the teaching of reproducible research as the topic of the CPD workshop offered in 2018/19.

A workshop on 'Teaching Reproducible Research' took place at the BPS London offices in November 2018. This participatory workshop blended presentations with structured 'hands on' activities. This approach was designed to offer professional updating and draw upon the considerable expertise in psychology education among the delegates. The workshop was attended by 23 delegates based at a range of settings including, a school, an academic publisher, and 14 universities.

In the first presentation, I provided a rough guide to the 'reproducibility crisis' as it affects psychology. This opened with infamous failures to replicate, and formal attempts to estimate the reproducibility of psychological science (e.g., Open Science Collaboration, 2015). Various 'questionable research practices' were then described that limit cumulative scientific progress, and affect many stages of the research process. For instance, the use of small sample sizes at the design stage contributes to underpowered research that inflates effect sizes present in the scientific literature. A schematic developed by Chris Chambers was used to illustrate pictorially where each questionable research practice is located within the normal hypothetico-deductive scientific process (Chambers, 2017).

In the second presentation, Dr Samuel Evans from the University of Westminster updated us on ways in which psychological science is responding to this problem. Sam's presentation described initiatives to make psychological science more reproducible, drawing on the influential "manifesto for reproducible science" (Munafò *et al.*, 2017). These initiatives were presented as responses to each of the questionable practices described in the first talk. For instance, as a countermeasure to the problem of small sample sizes, collaborations and consortia were recommended as opportunities to test larger samples. Recent changes to BPS accreditation standards that recognise collaborative final year projects facilitate the adoption of this initiative within the context of undergraduate education (BPS, 2019; see Button *et al.*, 2016). Other initiatives, such as open data and materials, incentives to replicate, and pre-registration also might be assimilated within psychology education, but have hitherto received less attention.

In a guided activity, delegates then considered how each of the initiatives described in the second talk apply to the teaching context, drawing out potential implications for practice. Six ways in which psychological science is changing were posted on the walls of our meeting room at the BPS London Offices. Over six 5 minute rounds, delegates mingled and discussed opportunities to adapt teaching practices in light of each initiative. We asked delegates to consider implications both for the empirical project, and for teaching research methods. Ideas were captured in the form of collective graffiti on the walls of the BPS offices (on temporary re-usable whiteboards). A selection of these ideas are presented in Table 1.

**** INSERT TABLE 1 ABOUT HERE ****

Following a brief interlude for lunch (kindly sponsored by Oxford University Press, during which members of the division attended the DART-P AGM), the afternoon session focussed on putting ideas into practice.

First up, was a case study of Teaching Reproducible Research presented by Dr Danijela Serbic, from Royal Holloway, University of London. Danijela described how internal pre-registration was introduced at Royal Holloway for the empirical research project. Project students complete a formative 'project proposal', based on an external pre-registration

system (aspredicted.org). Danijela explained how the project proposal assessment benefits students beyond training in Open Science practices. This includes improved project planning, increased understanding of research through early supervisory feedback, and less stress in later stages of project. She also described the challenges that were overcome including the design of the form, explaining the approach to students, and getting staff buy-in. This presentation provided us with an excellent concrete example of how psychology provision may adapt to keep step with developments in research practice.

Inspired by this case study, we then set to work planning educational change. Delegates self-organised into groups and chose an intervention that they would like to introduce within their own context. Interventions were informed by the collective brainstorming undertaken earlier, and drawn from those listed in Table 1. In a final plenary, intervention plans were shared with the rest of the group.

Feedback from the workshop was positive. On the BPS post-event survey, respondents judged the workshop to be useful (Mean = 4.7, on 5 point scale). One feature that was particularly appreciated was "the focus on translating ideas to teaching - not just thinking about research practice". At a later date, one delegate got in touch to report that they had changed their teaching as a direct consequence of having attended the workshop.

Materials from the Teaching Reproducible Research workshop are available, via the Open Science Framework, here: osf.io/3p8zy/. This includes slides for the three talks, and images capturing the delegates' work during the activities.

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Table 1: Opportunities for Teaching Reproducible Research, by potential locus of educational change: research methods training, empirical research project

	Research methods training	Empirical research project
Collaborative data collection	√	√
Pre-registered projects		√
Authentic statistics problem classes, using open data	√	
Replications, using open materials	√	√
Neither originality nor statistical significance should be assessment criteria for reports	√	√
Assess reports in two parts: Introduction & method (prior to data collection); analysis and interpretation (after data collection)		√