

Combatting the rise of paper mills

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I am writing this editorial less than a month before the beginning of a new academic year in the southern hemisphere, so in my day job I am preoccupied with preparing teaching materials. Part of that preparation involves checking assessments to reduce the chance of students engaging others to prepare their assignments for them as ghostwriters or, as they were called more recently, shadow authors (Tomar 2012). Concerned academics point to problems such as passing people who did not do the work themselves, turning student assignments into products to be traded, and setting up students and their assessors as adversaries instead of partners in education (Ritter 2005). It now seems that the problem of unacknowledged ghost writers is extending to scientific authorship.

Pressure to publish to further a career by gaining tenure or promotion has long been a feature of academic life. In recent years the growth of a range of research performance metrics has facilitated the evaluation of researchers' achievements (e.g. Oswald 2010), with rewards such as promotion or financial bonuses flowing to individuals and teams assessed as the most productive (Hvistendahl 2013). In other cases, researchers have been stressed by 'unrealistic research publication quotas' (Byrne and Christopher 2020, p. 583) simply to hold their jobs.

While some may be tempted to respond by submitting papers to predatory journals that will publish almost anything for a fee (Beall 2012), this approach may not satisfy institutional research managers who seek, rightly or wrongly, papers in journals with high impact factors (Adler *et al.* 2009). This has now led to the rise of new industries offering authorships on accepted papers, provision of data sets suitable for publication, or provision of data and writing the manuscript – all for a fee (Hvistendahl 2013). Thus data and writing research papers have become commodities to be bought or sold, following the pattern already established for student writing (Ritter 2005). Byrne and Christopher (2020) estimate that the business of clandestine paper mills, as the groups engaging in these activities is called, is currently worth US\$4.46 million annually in China, where pressures to publish are acute. Recent work on research cultures internationally confirms that these pressures are not confined to China but pose a challenge to science globally (Wellcome 2020).

Paper mills pose problems for many reasons. One key issue is that their contributions are covert, so that it is unclear which author is responsible for what components of a paper (White 2016). Although authors may legitimately outsource parts of a study (sending samples to be analysed in an external laboratory, for example), the key difference is that such

outsourcing is acknowledged in a legitimate paper but not in one written by a paper mill (Byrne and Christopher 2020). Furthermore, the goal of authors paying for a paper from a paper mill is to place the paper in a reputable journal, so if they succeed the work cannot be identified as readily as it would be if published in an acknowledged predatory journal. Finally, while a paper mill may produce genuine data, the business model requires many papers to be produced cheaply, which incentivises fabrication, falsification or augmentation of data (Byrne and Christopher 2020).

Submissions from paper mills can be challenging for journals, because they are often spread across a range of journals and authors. Annoyingly, paper mills often submit to multiple journals simultaneously, creating wasted work for editors and reviewers (Byrne and Christopher 2020). Warning signs include strong organisational similarities between papers suggesting that they were written to a template, which is particularly easy to do with some types of genetics analyses (Byrne *et al.* 2019). Another is the unacknowledged use of stock photos or manipulated images that are repeated across multiple papers (Christopher 2018).

For journals, strong disincentives to use paper mills include strengthening authors' declarations that each author has responsibility for one or more components of the paper and that all involvement with the work is covered by an authorship or an acknowledgement. These declarations may annoy authors, but in my opinion they are a small inconvenience compared with the potential proliferation of the outputs of paper mills. It is also helpful for journals to request that data are placed on record within the paper, its supplementary materials or an online data repository.

Beyond journals, institutions could shift their evaluations from simple metrics to close evaluation of a small subset of papers provided by a researcher and reconsider financial rewards for each paper published (Hvistendahl 2013). Numerous practical suggestions are given by Science Europe (2020). Those steps would remove much of the incentive to solicit work from paper mills in the first place. As noted by Wellcome (2020, p. 9) in assessing responses to a study of researchers' opinions of their work culture, such reforms are urgently needed:

'While many expected a career in academia to include long hours, high-pressured working environments and multiple commitments, historically these had been offset by benefits such as job security (once in permanent positions), autonomy, collaboration, creativity, flexibility, and the sense of

contributing to society. But many felt these previous advantages were increasingly negated by a system that was open to gaming, under financial pressure, and focussed on metrics at the cost of individuals.'

Researchers who turn to paper mills have responsibility for their actions, but questions should also be asked about a research culture that raises the temptation to turn to a paper mill so strongly.

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