an open access journal

Citation: Thelwall, M. (2021). Female contributions to high-energy physics in a wider context: Commentary on an article by Strumia. *Quantitative Science Studies*, *2*(1), 275–276. https://doi.org/10.1162/qss_c_00118

DOI:
https://doi.org/10.1162/qss_c_00118

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The MIT Press

COMMENTARY

Female contributions to high-energy physics in a wider context: Commentary on an article by Strumia

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Strumia's presentation at CERN in 2018 (Strumia, 2018) rightly drew widespread condemnation from the physics and wider scientific community (*Guardian*, 2018; *Independent*, 2018), including a petition with over 4,000 signatures, mainly from physicists (www.particlesforjustice.org). His article in this issue corrects the major flaws in the bibliometric part of his argument and contextualizes the results better in terms of confounding factors that differently affect men and women. Below I comment only on the published article and not on the presentation. To be honest, I found the presentation slides (I did not hear the talk) so offensive in style that I do not want to comment on the one important point in the slides that I agreed with.

The article by Strumia finds, among other things, that men tend to write more papers and attract more citations than women, and that this becomes increasingly true for the most productive and cited fraction in high-energy physics in the database studied. This occurs for reasons that could not be explained to the standard level of statistical significance with any of the confounding factors checked. To set this in context, my recent study showed that female first-authored research from the United Kingdom, United States, and Spain was more cited than male first-authored research, but the reverse in India and Turkey (Thelwall, 2018), so it is possible that one gender bibliometrically outperforms another in some ways of slicing up science, but this should not be extrapolated to all of science.

Do Strumia's high-energy physics results give strong evidence that males are somehow better at high-energy physics? Absolutely not. As the paper acknowledges, it is not possible to check all confounding factors and bibliometric indices are not reliable indicators of academic contributions, as they only reflect academic publishing and the academic impact of academic publishing. Nobody should make hiring decisions based on publishing and citations alone. Moreover, career-based bibliometric statistics involving gender are always hard to interpret because of the many factors that affect women more. Some of these are structural, such as lower retirement ages until recently, some are recorded and individual, such as career breaks or part-time working for carer responsibilities, and some are unrecorded, such as families unequally sharing childcare and other responsibilities outside working hours (affecting academics that research in their spare time) and sexism. It also seems likely that there are gender differences in teaching (Ceci, Ginther et al., 2014) and other nonpublishing contributions to universities in many countries and fields. It is entirely likely—although also unproven and inherently impossible to prove—that women make *greater* contributions to high-energy physics than men when the totality of both genders' contributions (publications and other) are considered. Although this is too difficult to measure, it should not be forgotten.

The low proportion of women in most science, technology, engineering, and mathematics (STEM) subjects in many countries is a concern. Initiatives such as Athena SWAN in the United

Kingdom and ADVANCE in the United States are attempting to redress this imbalance among university academics, and multiple attempts to redress the gender balance in the United Kingdom have led to a female majority taking exams for (optional) science subjects for the first time in 2019 (*Guardian*, 2019). Thousands of journal articles have also investigated the STEM gender disparity, with conflicting evidence of potential causes (Ceci et al., 2014). Of course, given our history of gender discrimination in education, the top priority should be ensuring that the lack of girls and women is not *still* due to sexism and gender discrimination at school, at university, and in hiring and promotion decisions, as well as in society generally. Part of this is ensuring that issues disproportionately affecting women, such as a greater likelihood of taking career breaks or periods of part-time working for carer responsibilities, do not hamper their choice of career or promotion prospects. It is also important to ensure that all members of society are fully free to choose careers, unconstrained by factors such as gender, ethnicity, wealth, or disability. Nobody should believe that they can't follow their career goals because of who they are, and nobody should have to fight against prejudice to get their career goals taken seriously and supported.

Against this background, it is always wonderful to hear female success stories in science. I can't imagine how hard it must have been for the female science Nobel Prize winners to fight through prejudice and sexism to make their contributions, and I hope—and believe—that it is easier for the current generation. These success stories must surely also help to create a culture in society where it is accepted that gender should not be a barrier to science careers, perhaps also creating role models for the next generation.

Personal preference also plays a role in career choices in richer nations. Since there are many female biologists but few female mathematicians, physicists, or computer scientists getting research degrees in the United Kingdom (HESA, 2018: Figure 18, postgraduate research degrees), for example, it is logical to wonder why scientific women disproportionately target biology whereas scientific men disproportionately target mathematics, physics, and computer science. As cited in the Strumia paper, one theory is that women value the societal benefits of careers more whereas men are more focused on individualized benefits (Diekman, Steinberg et al., 2017). This raises the possibility that fields such as high-energy physics, with a low proportion of women are, or are perceived to be, less directly beneficial to society. As a corollary of this, it is possible that the lack of women in high-energy physics is not *primarily* due to sexism but due to a lack of women that *want* to do it. If this is true, then the challenge for high-energy physics is to persuade women that it is worth doing.

REFERENCES

Ceci, S. J., Ginther, D. K., Kahn, S., & Williams, W. M. (2014). Women in academic science: A changing landscape. *Psychological Science in the Public Interest*, *15*(3), 75–141. **DOI:** https://doi.org/10.1177/1529100614541236, **PMID:** 26172066

Diekman, A. B., Steinberg, M., Brown, E. R., Belanger, A. L., & Clark, E. K. (2017). A goal congruity model of role entry, engagement, and exit: Understanding communal goal processes in STEM gender gaps. *Personality and Social Psychology Review*, *21*(2), 142–175. **DOI:** https://doi.org/10.1177/1088868316642141, **PMID:** 27052431

Guardian. (2018). 1,600 scientists rebuke CERN physicist over gender bias. https://www.theguardian.com/science/2018/oct/06/1600-scientists-sign-petition-against-cern-physicist-alessandro-strumia-open-discrimination.

Guardian. (2019). Female students outnumber males in A-level science entries. https://www.theguardian.com/education/2019/aug/15/female-students-outnumber-males-in-a-level-science-entries.

HESA. (2018). *Higher Education Student Statistics: UK, 2016/17—Qualifications achieved*. https://www.hesa.ac.uk/news/11-01-2018/sfr247-higher-education-student-statistics/qualifications.

Independent. (2018). Physicist who claimed 'physics was invented by men' suspended by CERN with immediate effect. https://www.independent.co.uk/life-style/women/physics-men-women-invented-alessandro-strumia-physicist-cern-workshop-talk-a8562801.html.

Strumia, A. (2018). Experimental test of a new global discrete symmetry. https://alessandrostrumiahome.files.wordpress.com/2019/03/strumiagenderslidescern.pdf.

Thelwall, M. (2018). Do females create higher impact research? Scopus citations and Mendeley readers for articles from five countries. *Journal of Informetrics*, *12*(4), 1031–1041. **DOI:** https://doi.org/10.1016/j.joi.2018.08.005