Who Finishes in the Marathon of Science: Experiences and Motivation of Postgraduates in Physics and Biology

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Please mind the (gender) gap

STEM graduates earn higher wages and are more likely to be employed (University of Warwick, 2011)

But not everyone is benefitting. Around the world, only 29% of scientific researchers and 15% of engineers are female (SWE, 2022; UNESCO, 2019).

This phenomenon exists across nations and cultures and educational levels from secondary school to doctoral studies.

Theories: the pipe, the schoolbag, and the wardrobe

Why does the gap exist? I consider two theories: the pipe and the schoolbag.

Pipeline theory compares progressing in STEM to travelling along a pipeline. Blickenstaff (2005) claimed "leaks" along the pipeline disproportionately affecting women cause the gender gap.

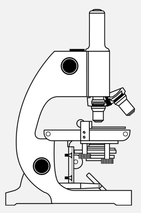
Science Capital Theory aruges that children's experiences change their STEM aspirations and perceptions (Archer et al., 2015; Archer, DeWitt, and Wong, 2014). The child has an experience "schoolbag" holding their STEM equipment, which changes their tools and paths.

Young men and women without equals

A total of 14 postgraduates from the University of Leeds participated in this study. They included the following:

Eght students from the School of Physics and Astronomy, and five students from the Faculty of Biological Sciences.

There were nine females and six males, for a majoirity female sample.



Demographic data collectied following interviews shows diversity in participants' racial/ethnic and national backgrounds, as well as exposure to the sciences and motivation for pursuing further study.

What's in a name? That which we call...

Much like if tomatoes are fruit or vegetable, which subjects are STEM is debatable. Smith (2011) cites Pigliucci (2008) stating divides between the "hard" and "soft" sciences, while others include the life and social sciences (Smith, 2011; Koonce et al., 2012). I use the index by Koonce et al (2012), which includes both biology and physics in STEM.

I want (my research design) that way

Why biology and physics? I wanted to study the underesearched topic of why gender gaps between STEM subjects are different as well as minority gender experiences in STEM (Cheryan et al., 2017; OECD 2017). Investigating majority-male physics and majority-female biology is perfect.

Why use postgraduate students? Both Pipeline Theory and Science Capital Theory were developed from observing secondary schoolers, with gaps in understanding of their applicability to postgraduate study.

Why interview? Interviews are suitable for investigating "difficult to measure, complex, and interwoven" topics (Almalki, 2016). Semi-structured interviews benefit from open responses alongside structure.

Questions through the looking glass

1. Science Capital and Childhood "To what extent are childhood science capital and secondary schooling encounters important later on in life for postgraduates in STEM?"
2. Motivation for Postgraduate Study. "What are the most significant factors that encourage students to apply to a postgraduate education in physics and biology?"
3. Gender-Specific Experiences in Postgraduate Study "To what extent, if any, do male and female students in physics and biology postgraduate programmes have differing experiences when studying STEM?"

Seeking truth by analysing facts

Interviews were first organised using Taguette, a qualitative analysis software to identify common themes.

I then primarily used a thematic analysis methodology, with elements of deductive data analysis (Barnes and Atfield, 2014; Braun and Clark, 2006). I was also inspired by Archer, DeWitt, and Wong (2014).

When analysing childhood encounters, early motivation, and science capital, several groups of respondents emerged. I explain them in detail below.

Do STEM students dream of electric sheep?

Early Resolvers were more likely to voice high self-efficacy in STEM, chose a STEM education/career earlier, and expressed enjoyment of STEM.

Subject of Convenience often wavered between subjects in school, choosing their A-level and/or university subjects late, and selecting courses due to perceived ease or convenience.

Career Drivers expressed certainty of their desired subject, but less likely to express outright enthusiasm, instead emphasise their degree as a steppingstone to future endeavours.

Bright dreams of sons and daughters

So, how did gender impact responses in each area?

I: Childhood Encounters, Rationale, and Science Capital

Most males were "Early Resolvers" (3 of 5), while females were evenly split. While group characteristics appeared to matter more than gender when it came to childhood experiences, respondents within the "Early Resolvers" tended to fit a traditional masculine image of science in "pursuing something singlemindedly". Also, many respondents in this cateogry were studying physics, a traditional "STEM" subject.

II: Motivation for Postgraduate Study
Personality groupings appeared to explain most of the differences between individuals when it came to rationale for continuing study, with gender seemingly less relevant.

III: Gender Experiences in Postgraduate Study
Generally, females were more likely to discuss the gender gaps in experience including participation, while many males described no signs of gender differences including peer/treatment faculty or course participation. Despite predictions males in female-dominated biology would be more reflective on gender, females in biology were more reflective, with some noting the gender difference and atmosphere for males. Differences in gender treatment were usually acknowledged as the result of culture and peer interactions.

Towards the future, the stars, and the abyss

The following policy and research recommendations are made:

1) More research should be done on STEM subjects such as between chemistry, maths, and computer science so that further comparisons may be made between subjects

2) Policymakers should consider methods of emphasising STEM's benefits and relevance to appeal to broader groups such as *Career Drivers* and *Subject of Convenience*

3) Continue to review strategies to ensure students of all levels feel welcome their science experience

References

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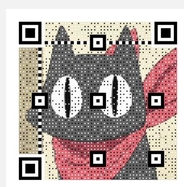

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