The following paper was written during LSE GROUPS 2019.

LSE GROUPS takes place during the final fortnight of the summer term. Undergraduate students are placed in small groups; these are cross-year, interdisciplinary, and group members do not know one another in advance. Each group must then devise its own research question, and carry out all stages of a small-scale research project in less than two weeks. The overall theme of LSE GROUPS 2019 was The Future of Work.

This paper was submitted on the final Thursday afternoon of the project. (Students then presented their work at a conference, on the closing Friday.)

More information on LSE GROUPS, and other papers.

Papers are presented as submitted, without corrections.

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The STEM transition gap in the UK:  
Why women opt out of STEM careers after graduation?

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Abstract

The Department of Education of UK Government claims that girls are much less likely than boys to consider taking STEM subjects at A-level. Therefore, government
policy encourages women to study STEM subjects in higher education. Yet in practice many campaigns have shown that women are underrepresented in STEM industries, and there is little knowledge about what stops them from entering STEM industries after graduation. This research paper examines the reasons behind the gap between female STEM degree holders and female employees in the STEM fields and identifies the most significant factors. From a review of the literature on this subject, we identify three key factors that may contribute to this gap: pay-related, gender-related and non-gender related working conditions. Using mixed methodology, online surveys identified that male-dominated industries, stereotypes of gender roles and working hours are the biggest barriers to entry for women into STEM fields. Our qualitative data from six in-depth interviews with female graduate students and academics illuminates that a lack of role models and stereotypes from a young age are where the most change needs to take place. This research paper has implications for policy makers working on bridging the STEM transition gap and achieving gender equality within STEM fields.

**Keywords:** women, STEM, employment, higher education, gender gap

**Introduction**

Increasing awareness of women’s rights and interventions on gender equality have encouraged more women to break gender stereotypes and enter non-traditional workspaces, such as STEM industries. According to Deloitte, United Kingdom
(2019), although women make up nearly 52 percent in pursuing STEM degrees, only 14 percent enter the STEM workforce in the United Kingdom. It has been estimated that 70 percent of women with STEM qualifications are working in non-STEM related industries.

Therefore, our focus is on why there is a gap between female STEM degree holders and females who work in the STEM fields in the UK, which will be referred to in the rest of this paper as ‘the STEM transition gap’. We define STEM as ‘Science, Technology, Engineering, Mathematics’, and defines STEM jobs to include academia and professional occupations.

Our guiding hypothesis is that factors concerning gender-related working conditions are the most important concerns for women’s decision-making to enter STEM fields. We summarise these three categories of factors from the literature based on the criteria of mutual exclusiveness and collective exhaustiveness. We will use surveys to investigate the frequency to which participants identify pay, gender-related and non-gender related factors to be important, and conduct one-to-one interviews to find out why those factors are important and how do they affect interviewees’ occupational decisions in individual cases.

This paper starts off by examining existing literature, before proceeding to outline of mixed methodology employed to compile our data. Following the results of three crosstabs based on online surveys and interviews will be discussed to test our hypothesis. We conclude by highlighting important factors hindering entry of women into STEM after their degrees. This will serve as groundwork for suggestions for policy makers on how to bridge the STEM transition gap in order to promote diversity and gender equality within the STEM fields. Our originality arises from the in-depth interviews, while our research contributes to the fields of education, policies and the future of work.

**Literature Review**
Findings by the Institution of Engineering and Technology which show that from 2012 to 2015 only 51% of female STEM graduates go into STEM roles, and while they represent 47% of the UK workforce, women only represent 13% of the STEM workforce. The report also points out imbalances within STEM, with 79.4% of medicine undergraduates being women, while only 17.4% of computer science undergraduates are women (IET, 2015). This indicates that issues with the STEM transition gap may affect some industries more than others.

Various literature supports that women make occupational decisions based on level of pay. According to data from the Hay Group Division of Korn Ferry, STEM graduates can earn nearly 20% more than their peers. However, even in highly paid industries like engineering, women earn a fifth less than their male colleagues in the UK and this gender pay gap increases with age and experience (New Scientist and SRG, 2017). As Xu (2015) suggested, women are less likely to pursue a career in STEM fields knowing that they may experience persistent earning disadvantages. Fouad and Singh's (2011) study of women engineers came to somewhat similar conclusions: nearly half the women in their sample of women with engineering degrees said they left engineering because of lack of advancement or low salary, along with other working conditions.

Women in STEM careers suffer from work-life imbalance. Some women complain that they have little support on maternity leave (Mavriplis et al., 2010), and face difficulties handling the conflict between raising families and pursuing career success (De Welde and Laursen, 2011). Moreover, a lack of role models further discourages women from entering STEM careers.

Historically, technological industries have had a lack of female role models, where at senior level just 16% of people are female, dropping to 10% at executive level (Manielevitch and Manielevitch, 2019). Moreover, men comprise the majority of STEM faculty at universities, which gives women the perception that they cannot succeed in these fields (Herrmann et al., 2016). This underrepresentation of women will also enlarge the gender gap, as fewer graduates serve as role models for the next
generation of women in STEM (Herrmann et al., 2016). Moreover, male-dominated working environment makes women even less motivated to enter STEM industries. Women are excluded from the ‘old boys’ club—the informal networks that keep girls out of academic or extracurricular activities (De Welde and Laursen, 2011). The feeling of being ‘outsiders’ threatens their performance and confidence even in the domain that they are excel at. The general thinking in the past is that men were more suited for STEM jobs, so girls may be informed from a young age that they should not follow STEM careers. Women in STEM perceive the working environment as less positive and supportive (Glass et al., 2013), and sometimes suffer from harassment (De Welde and Laursen, 2011).

In addition, working conditions not related to gender may influence women’s entry or retention in STEM fields. For academia, the satisfaction acquired through teaching and researching attracts both men and men to enter the field. Dissatisfaction arises if employees fail to sense the opportunities for advancement and feel isolated when sitting in front of the computer (Mavriplis, 2010). Williams and Ceci (2012) suggest that career in STEM is less conducive to family building than other occupations. Spousal support is important for women to remain in the STEM career, as the retention rate of women in STEM fields is higher if their spouses are scientists (Glass, 2013).

**Methodology**

Online surveys were conducted to investigate the factors influencing women’s entry into STEM careers. We distributed our survey to the relevant departments, student social media groups, and student unions around the UK.

We released three versions of survey for different targeted groups. First, we researched the students who are now studying STEM degrees in the UK. The purpose is to inquire their potential career plans after graduation and factors influencing their choices. The second version of the survey was aimed at Chinese students and written in Chinese with identical content to the first one, increasing the total sample size and
utilising our language skills and reachability to Chinese students. The third was targeted at female STEM graduates — how they choose their current careers. The survey contains both close-ended and open-ended questions. Close-ended questions investigate how participants agree with the importance of the factors listed. Their concerns are specified if they agreed that the factors mentioned affect their choices. Respondents were also encouraged to share more about their experience in the open-ended questions to cover the missed factors.

In addition to the quantitative survey, we conducted six in-depth interviews to specifically study the influence of different factors either face-to-face or through Skype. The interview sample consisted of two guest teachers from the Department of Mathematics at LSE, two PhD science students, one master student and one final year undergraduate student. The interviews consist of follow-up questions of the survey and experience-sharing answers from the interviewees. All interviews were conducted on a confidential basis while consent forms were signed by interviewees beforehand. The interviews were recorded and transcribed for thematic analysis.

**Survey analysis**

We collected 55 survey responses for the student version and 53 of them are useful responses. We collected 10 responses from the employee version, so they may not be analyzed into crosstabs. We translated the Chinese version and integrate it with the English version. Main results are analyzed by crosstabs and graphs are shown in appendices.

For the employee version of survey, most of them identified level of pay and job security is the most important factors they are considering.

According to the crosstabs, 48%, 59.7%, 75% of respondents agree or strongly agree to the importance of gender-related factors, level of pay and non-gender related factors respectively.
The respondents were also asked to specify their concerns if they agree gender-related and non-gender related working conditions are important in their decision-making process. In gender-related working conditions, six possible concerns are provided as choices: male dominance (lack of sense of belonging to the community because of gender), lack of female role models, lack of maternity care, lack of chances for promotion for women, gender stereotypes and sexual harassment. The two most frequently-mentioned concerns are gender stereotyped that men are more fit for STEM jobs (21 out of 28 respondents who agree gender-related working condition is important) and lack of opportunities for promotion (20 out of 28). Lack of female role models is the least chosen concern (8 out of 28).

In non-gender related working conditions, five possible concerns are given as choices: daily working hours, annual leave, physical working environment (dirty, dangerous or hazardous), atmosphere in the working places (job pressure) and lack of STEM jobs related to the degree taken. The two most frequently mentioned concerns are working hours (32 out of 48 respondents who agreed to the importance of non-gender related working conditions) and atmosphere at working places (31 out of 48). The least mentioned is lack of STEM jobs directly related to the degree taken (11 out of 48).

According to the survey, we found out all three factors present importance to the career decision-making process (48%, 59.7% and 75% respectively for gender-related factors, level of pay and non-gender related factors). Non-gender related working conditions are most important among three factors, while working hours and atmosphere in the working environment are the two most important factors. While they are nominated as non-gender related factors, the evaluation of working hours and atmosphere may be biased because of gender. For instance, the traditional gender role requires women to spend more time within family, which generated their demands for less working hours. The different evaluation of non-gender related factors by different genders may contribute to the gender imbalance in the STEM industries.

The gender-related working conditions contribute to the ‘STEM transition gap’ more directly than non-gender related working conditions. Threat of sexual harassment may
influence women’s decision to stay or enter in the field (De Welde, 2011). Women do not receive enough care in STEM working places if they want to have children (Glass, 2013). These gender-centered concerns will contribute to the ‘STEM transition gap’ and gender imbalance in STEM fields.

Respondents regard level of pay as important for the decision-making process. The existence of a gender pay gap in the STEM industries may deter women to other well-paid industries for women.

**Interview Analysis**

From our interviews, we identified four key themes that reappeared throughout the discussions.

The first theme was the emphasis on perceptions, shaped by stereotypes, families and a distinct lack of role models for women in STEM industries. Out of the six interviews, five stressed misperceptions developed from an early age and children’s expectations of scientists and people working in STEM fields. One graduate student who was interviewed works as a STEM Ambassador, and can attest to these stereotypes developing from a younger age, while another graduate student who has volunteered in schools said that when she asks children what a scientist looks like, “they always say ‘a man in a lab coat, with crazy hair’”. The work of Katrina Piatek-Jimenez is particularly supportive of this, showing evidence that strongly suggests women’s perceptions hinder their participation in STEM fields (Piatek-Jimenez, 2008) and extensive ‘Draw-a-Scientist’ tests that correlate with our interview findings (Piatek-Jimenez, 2018).

The attitude of family was an important element for most of the interviewees. There was a notable example of one graduate student who said she comes “from a traditional family, where I have to do some convincing work with my parents that there is nothing wrong for girls trying to do subjects that are considered to be masculine”. Family has a significant role in the choices of women growing up, and
that although they are able to defy expectations and pursue STEM due to their passion of it, for other women it is a significant barrier. Furthermore, education at an early age (i.e. primary school, GCSE, etc) is essential for tackling down the stereotype of gender role problem, not only girls but also boys should receive education concerning gender equality.

The second theme is gender imbalance and discrimination in and out of STEM. In undergraduate level, one interviewee said there are around 30 percent of women doing Material Science in her university however, the ratio dropped sharply in other departments, especially Technology and Engineering. Two interviewees stressed that there are more men doing STEM majors in the first place which leads to more applications and job offers for men. Moreover, women in STEM fields are not surrounded by enough women to help them see the possibility of success in the industry, as one interviewee mentioned ‘I am a mature student but also need to struggle for this’. Besides, women feel isolated and disadvantaged in such male-dominated environment. One interviewee mentioned that ‘no one wants to include them in their group since they are the only girl and boys make joke about them’.

The third theme which four interviewees expressed concerns about was maternity leave which may discourage women not only from entering but also staying in STEM careers for long. This theme corresponds to the findings in the survey. One interviewee even suggested that it was difficult to ask clearly about the maternity leave policy during job interviews, as employers may be less likely to hire them if they expect the candidate plans to take leave soon after they start work. Another interviewee said that taking a year out will affect their research project, and the person will be looked down upon by colleagues when come back. Being pregnant negatively affects the progress of work. One interviewee stressed that special care was needed when being pregnant: laboratory scientists have to read the ingredient lists of bottles, and there is a dilemma over whether they should let their colleagues know that they are pregnant. Three interviewees suggested that it might be difficult to move on or to even hold on the position in their work in maternity leave. This is supported by existing literature saying that the ‘all-or-nothing atmosphere’ of the position leaves
women little time for having maternity leave (Mavriplis et al., 2010). One suggestion from an interviewee was to have equal parental leave of six months for both men and women, which will give men the experience that women go through on returning to work after leave.

The fourth theme discussed the role of gender quotas. Three out of six interviewees identify uses of similar policies to quotas in their universities. Empirical evidences show that gender quota works in terms of raising the proportion of women inside a community (World Economic Forum, 2019). However, four interviewees believed that gender quota does not help to solve the fundamental problem of people’s perceptions towards gender stereotypes, moreover, it diminishes women’s achievement in some sense. Two interviewees reported that during their PhD application processes, they have been told multiple times that they do not need to worry about not getting in since there’s quota for women. And they received negative comments from their male coursemates that female students are there to fill in the quota, not because they are as worthy as other people. Women want to prove that they are merited as men, as commented by one interviewee.

**Limitations**

Although our study provides detailed explanation of why women leave STEM field after they graduate, there are some limitations that need to be acknowledged and which serve as potential areas for future research to investigate. Firstly, due to the time constraint, we haven’t managed to obtain a large enough sample size to do regression where more accurate effect can be generated. Secondly, since there are many Chinese students in our sample, this may cause bias as there may exist country-specific factors that affects women’s decision of continuing in STEM fields. Thirdly, as all of our interviewees are in the academia side, either as students or teachers, we are not able to draw a full picture of the women’s participation in the STEM field as there is not enough data from the industry side. Moreover, as all of the interviewees are willing to enter or stay in the STEM fields while there is a lack of data from women leaving the industry, the experience might be entirely different for those
staying in the industry which is not captured in our interview. In addition, as we only focus on the participation in the UK, this might be a universal issue where further research can be done.

**Conclusion**

The existence of ‘STEM transition gap’ displays the gender imbalance in the STEM industries which is continuously increasing. The low proportion of women in the STEM careers does not match with the fact that nearly half of STEM degrees are earned by women.

To investigate this gap, we examined the literature before theorising three possible factors for the STEM transition gap: gender-related working conditions, non-gender related working conditions and level of pay. Using evidence collected by surveys and interviews, we present the importance of all three factors in women’s decision to enter the STEM field and how these factors contribute to the ‘STEM transition gap’. Male dominance, lack of chances for promotion and maternity care are important factors identified by the respondents.

The implications of our findings are clear: more action needs to be taken by the UK government, by higher education providers and schools as well as by companies in STEM industries in order to welcome more women into those fields. Implementing quotas for women is only a nominal solution, and fails to remove gender imbalances as they encourage gender discrimination who are perceived to only receive their place for their gender, while fundamental perceptions and stereotypes surrounding the STEM fields remain the same. Our interview responses contribute to some areas of improvement for policymakers, such as the implementation of equal parental leave for both genders and infrastructure for maternal uses in STEM workplaces. Our insights also contributes to gender equality by promoting more conducive working environment for women.
Notes

We want to offer great thanks for the help received from our supervisor, Dr Paroj Banerjee. We also want to thank all the lecturers of the resource sessions. Moreover, we are grateful for the help and guidance from all the faculties conducting LSE GROUPS, especially Dr Ellis Saxey. Thanks to all the participants and interviewees who spend time on our research project.
Special thanks to Department of Materials at Imperial College London, Department of Mathematics at LSE and Department of Natural Science from University of Cambridge for distributing the survey.

**Bibliography**


Appendices
The respondents are asked if they agree with the statements that pay, gender-related working condition and non-gender-related working conditions are important. Their
attitudes are coded into 1 to 5 from ‘strongly disagree’ to ‘strongly agree’. Their are also required to identify their choices whether they are entering STEM fields after graduation and coded as ‘2’ for ‘yes’, ‘1’ for maybe ‘0’ for ‘no’.

Figure. 1

Are you planning to enter STEM field in the near future? * Working conditions related to gender (e.g. male dominance, no role models, maternity care) are an important factor in your decision making. Do you agree with the statement? Crosstabulation

<table>
<thead>
<tr>
<th>Are you planning to enter STEM field in the near future?</th>
<th>0</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>% within Are you planning to enter STEM field in the near future?</td>
<td>0.0%</td>
<td>20.0%</td>
<td>20.0%</td>
<td>40.0%</td>
<td>20.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Count</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure. 2

Are you planning to enter STEM field in the near future? * Level of pay is an important factor in your decision making to enter or not a STEM career field. Do you agree with the statement? Crosstabulation

<table>
<thead>
<tr>
<th>Are you planning to enter STEM field in the near future?</th>
<th>0</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>% within Are you planning to enter STEM field in the near future?</td>
<td>11.5%</td>
<td>17.3%</td>
<td>23.1%</td>
<td>28.9%</td>
<td>19.2%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Count</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>52</td>
</tr>
</tbody>
</table>

This crosstab has working conditions related to gender at column and the choices to enter STEM fields or not at row. The result shows that 48% of women (where is this shown in the table) agree or strongly agree with the statement that working conditions related to gender is an important factor when they are making career decisions. 60% of women who decided not to enter STEM fields agree with the statement.

According to Figure.2, the second crosstab has level of pay at column and the choices to enter STEM fields or not at row. The result shows that 59.7% of women consider
agree with the statement that working conditions related to gender is an important factor during career decision-making process. Specifically, 70% of women who decided not to enter STEM fields agree with the importance of level of pay.

Figure.3

The third crosstab in Figure.3 has level of pay at column and the plans to enter STEM fields or not at row. The result shows that 75% of women in total agree or strongly with the statement that working conditions related to gender is an important factor during career decision-making process.