EVALUATING THE IMPACT OF ENTERPRISE EDUCATION COMPETITIONS UPON ENTREPRENEURIAL INTENTIONS OF STEMM WOMEN EARLY CAREER RESEARCHERS

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Abstract

This thesis explores whether an enterprise education competition (EEC), promoted as best practice vehicle of entrepreneurial education (EE), may have gendered outcomes in terms of differential impacts upon women participants, given mixed findings relating to the efficacy of EE for women which is considered to relate to the acknowledged masculine construction of entrepreneurship. Thus, this thesis investigates the influence of an EEC on the entrepreneurial self-efficacy (ESE), entrepreneurial intentions (EI) and perceived gender barriers to entrepreneurship of STEMM women early career researchers (ECRs). Of novelty, the theoretical framework draws upon Social Cognitive Career Theory (SCCT), from the career literature, which captures the socio-economic influences of perceived gender barriers upon entrepreneurial career intentions, while also exploring the predispositions of men and women EEC participants.

Underpinned by a critical realist methodology, a quantitative study of 120 pre- and post-surveys of men and women participants, followed by 45 semi-structured interviews of women participants, were undertaken. The quantitative findings suggest that EEC participation removed the gender gap in: (a) perceived stereotype threat, (b) perceived networking difficulty and (c) perceived ability related to entrepreneurial finance and cost estimation. However, following EEC participation, women participants continued to perceive high barriers in: (a) sex discrimination, (b) childcare-work conflict and (c) a lack of role models and mentors when compared to their male counterparts. In addition, the EEC deterred self-confidence in ESE of women participants who perceived a high barrier in stereotype threat.

Despite this, evidence from the qualitative study suggests that the EEC programme still reproduced unintended gendered outcomes for some women participants, particularly in: (a) perpetuating the stereotypical masculine stereotypes of an entrepreneur, (b) reinforcing perceived conflict between childcare and work-life of a woman entrepreneur as well as (c) highlighting a negative image of STEMM women entrepreneurs.

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To my family –

past, present and future

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1. Introduction

The UK government recognises STEMM (Science, Technology, Engineering, Mathematics and Medicine) entrepreneurial activity as a key driver of the knowledge-intensive economy (Kuschel *et al.*, 2020). This has raised the government's expectation towards the contributions of STEMM entrepreneurial and research commercialisation acitivities (Audretsch, 2014). Indeed, the commercialisation of university research and academic spin-offs has been growing since the late 1980s (Bienkowska *et al.*, 2016). Yet, the underrepresentation of women within STEMM workforce and the shortage of skills related to STEMM entrepreneurship have been identified as two of the key developmental problems (NAO, 2018). Government policy aimed at closing the gender gap within STEMM entrepreneurship has enjoyed some success; however, greater numbers of women in STEMM have not translated into increased rates of STEMM academic entrepreneurship among women (Shaw and Hess, 2018). Only 13% of UK university spinouts have female founders or co-founders (Griffiths and Humbert, 2019).

As entrepreneurial education (EE) fosters entrepreneurial competences and intentions, equipping individuals to generate and realise ideas (Lackéus, 2020; Pocek *et al.*, 2022), it may contribute to increasing STEMM women's entrepreneurial activities (Neumeyer, 2020). According to the Quality Assurance Agency for Higher Education (2018), several terms were introduced to identify education programmes in entrepreneurship, including entrepreneurship education, enterprise education and entrepreneurial education. While entrepreneurship education *"aims to build upon the enterprising competencies of students"* to become an entrepreneur, enterprise education focuses upon enhancing students' employability through developing their competencies to generate original ideas and solve problems in a changing and ambiguous environment (QAA, 2018, p. 9). Among these terms, entrepreneurial education (EE) serves as the umbrella term that encompasses both entrepreneurship and enterprise education (QAA, 2018).

Despite this, the effectiveness of EE programmes for women is questioned given their reportedly lower entrepreneurial intentions (EI) than men post-participation (Westhead and Solesvik, 2016), with women considering entrepreneurship a less suitable career option (Nowiński *et al.*, 2019). This is related to feminist critiques regarding: (a) invisible structural barriers STEMM women are facing (Hughes *et al.*, 2017), (b) gender assumptions within entrepreneurship and its educaiton (Jones and Warhuus, 2018), and (c) the need to investigate the deeply embedded cultural and social cognitive associations that frame STEMM entrepreneurship as masculine concepts and how these ideas affect STEMM women's career interest, progression and retention, particularly within STEMM entrepreneurship (Wheadon and Duval-Couetil, 2018).

Enterprise education competitions (EECs) are, herein, defined as experience-based learning activities requiring individuals or teams to develop proposals for products or services (Brentnall *et al.*, 2018a), which are then judged by a group of industrial and investment experts on their commercial merits, with the best individuals or teams being rewarded (Watson *et al.*, 2018). Within higher education (HE), such EECs and/or business plan competitions are employed as a pedagogical tool to enhance students' entrepreneurial activity (Wegner *et al.*, 2019). However, EECs in HE are not without critique (McGowan *et al.*, 2012; Wegner *et al.*, 2019). They are criticised for reproducing the typical 'middle-class' entrepreneurial norm (Brentnall *et al.*, 2018b). If the masculine entrepreneurial norm is reproduced, this could lessen the EI of women generally, and STEMM women in HE specifically, given the prevailing masculine culture in STEMM sectors (Neumeyer, 2020).

The Young Entrepreneur Scheme (YES) 2019, the focal EEC of this thesis, is a three-day national EEC specifically designed to enhance the commercialisation knowledge and communication skillset among UK STEMM early career researchers (ECRs) comprising doctoral students and post-doctoral researchers (Treanor *et al.*, 2021). This thesis focuses on this sample due to an emerging but overlooked phenomenon of entrepreneurial activity among STEMM ECRs, which

is a potential contributor to economic development (Muscio and Ramaciotti, 2019). This EEC, open only to STEMM ECRs at UK universities and research institutes, has occurred annually since 1990, organised by the University of Nottingham's Haydn Green Institute for Innovation and Entrepreneurship (HGI) in partnership with the Biotechnology and Biological Sciences Research Council (BBSRC); industry sponsors in 2019 were GlaxoSmithKline plc (GSK) and Syngenta.

This thesis addresses three key knowledge gaps within the areas of entrepreneurship, EE and gender. First, there is limited understanding of the influence of EECs upon women and socio-cultural factors, particularly perceived gender barriers to entrepreneurship, as potential determinants to EI (Jones and Warhuus, 2018). Second, there is limited understanding of the gendered process and outcomes of EE programmes and how they affect women's entrepreneurial interest and proclivities (Hughes *et al.*, 2017; Wheadon and Duval-Couetil, 2018). Third, this thesis responds to calls for an alternative intentions model to explore insights, implications, conditions and exceptions of EE's impact on EI (Liguori *et al.*, 2019).

Therefore, the thesis addresses the following research question:

> "To what extent does the EEC, as a vehicle of EE, influence perceived gender barriers to entrepreneurship, ESE and in turn EI of STEMM women ECRs?"

The objectives of the research are:

1) To investigate the extent to which the EEC programme impacts perceived gender barriers to entrepreneurship, ESE and EI of STEMM women ECRs;
2) To investigate to what extent perceived gender barriers to entrepreneurship influence ESE and EI of STEMM women ECRs, and;
3) To investigate to what extent the potential impact of the EEC programme is influenced by individual predispositions.

Underpinned by a critical realist stance, this thesis employed a two-process mixed-methods approach, specifically the Explanatory Sequential Design (QUAN → Qual). The thesis initially conducted the quantitative study followed by the qualitative study. A quantitative study using 120 pre- and post-surveys of men and women EEC participants followed by 45 semi-structured interviews of EEC women participants were undertaken. The quantitative data were analysed using *t-tests*, difference-in-differences, and regression analysis. The thematic analysis was employed to analyse the interview data.

This thesis contributes to the theories in EE, EI and gender by providing novel insights into the unintended gendered outcomes of the EEC programme, in response to feminist critiques regarding the assumed benefits of EE programmes in enhancing women's ESE and EI (Foss *et al.*, 2018). It provides theoretical understanding of this enquiry that the EEC programme indeed unconsciously reproduced gendered outcomes for women participants; lending support to the contention that structural issues, rather than essentialist deficiencies among women, underpin their differential participation rates in STEMM innovation within academic and industry employment environments, with consequential effects on women's STEMM self-employment (Kuschel *et al.*, 2020; Neumeyer, 2020). In addition, this thesis contributes to the development of Social Cognitive Career Theory by capturing a socio-economic aspect of perceived gender barriers to entrepreneurship as well as individual predisposition; contributing to the theoretical development of EI through analysis that reveals perceived structural barriers as key EE impact measures (Jones and Warhuus, 2018) and critical factors influencing EI (Laguía et al., 2022).

This thesis is structured as follows. Chapter 1, Introduction, introduces and justifies the aims of the thesis. The chapter briefly introduces the focal EEC of this thesis, research methodology employed and key theoretical contributions of the study.

Chapter 2, An Ongoing Quest into Promoting STEMM Women Entrepreneurship, presents an analytical view of entrepreneurship, women entrepreneurship and

EE literature by analysing feminist critiques regarding gendered assumptions within STEMM entrepreneurship and its education, as well as the assumed benefits of EECs in enhancing perceived women's ESE and EI. Consequently, the chapter highlights a conspicuous research gap in terms of exploring the role of socio-economic factors, particularly structural barriers, as potential EE impact measures and critical factors influencing women's EI.

Chapter 3, Perceived Gender Barriers to Entrepreneurship and Entrepreneurial Intentions of STEMM Women, provides theoretical background and critical analysis of the key constructs of the thesis, including EI, ESE and perceived gender barriers to entrepreneurship. The chapter provides the analysis of critiques on the dominant intention-based models in entrepreneurship and proposes SCCT as an appropriate analytical framework to explore STEMM women's EI. The chapter identifies a number of gender barriers to entrepreneurship and highlights knowledge gaps in exploring them as key determinants of EI and key EE impact measures.

Chapter 4, Research Hypotheses, identifies the hypotheses used in the study to formulate the analytical model for the quantitative analysis. The chapter presents an analysis of empirical evidence to predict the relationships between the EEC programme and each key construct. It then proposes the analytical framework to investigate the impact of the EEC programme upon perceived gender barriers to entrepreneurship, ESE and EI of EEC participants.

Chapter 5, Research Methodology, provides an analysis of philosophical assumptions and details on research methods employed in this thesis. It justifies the thesis' employment of critical realist philosophy underlying a mixed methods approach in advancing our understanding of the influence of gender and EEC impact upon women participants. Subsequently, the detailed research strategy is outlined, and the ethical considerations of the thesis are discussed.

Chapter 6, Quantitative Results, provides the statistical analyses of the quantitative data to test the hypotheses of the study. The chapter presents the overall impact of EEC on perceived gender barriers to entrepreneurship, ESE and

EI of women participants in comparison to their male counterparts. In addition, several gender implications arising from the quantitative findings were identified. Finally, the chapter provides the summary table connecting the quantitative findings to the qualitative analysis.

Chapter 7, Qualitative Results, presents the thematic analysis of semi-structured interviews with 45 women participants from which three themes were identified: (1) entrepreneurial motivation of STEMM women ECRs, (2) gendered outcomes of the EEC programme, and (3) intentions to start a non-STEMM business and perceived barriers to STEMM entrepreneurship.

Chapter 8, Discussion, presents the synthesis and analysis of the quantitative and qualitative findings as well as their significance to existing literature. The chapter provides novel insights into the differential EEC impact between men and women participants, the differences among women participants as well as the reasons behind the alignments and conflicts between the quantitative and qualitative findings.

Chapter 9, Conclusion, provides the conclusion of this thesis, its theoretical and empirical contributions as well as its limitations, implications and future research directions for researchers, practitioners, and policy makers.

2. An Ongoing Quest into Promoting STEMM Women Entrepreneurship

This chapter presents an analytical view of entrepreneurship, gender and EE literature. In addition, it draws upon feminist critiques regarding gendered assumptions within STEMM entrepreneurship and its education as well as the assumed benefits of enterprise education competitions (EECs) in enhancing women's perceived self-efficacy and intentions to start a business. Consequently, the chapter articulates the potential role of EECs in: (1) reproducing masculine gender bias, (2) increasing perceived gender barriers to entrepreneurship and, in turn, (3) undermining women from pursuing a career in STEMM entrepreneurship. The chapter begins by analysing how the neoliberal ideology has highlighted the importance of research commercialisation and entrepreneurial activity, among the STEMM ECRs, to economic development (Berglund *et al.*, 2018; Muscio and Ramaciotti, 2019). Subsequently, it discusses the longstanding issues around the retention and progression of women within STEMM entrepreneurship as well as the limited success of education and training programmes promoting STEMM women entrepreneurship (NAO, 2018; WES, 2018). Then, it articulates the masculine gender bias embedded within entrepreneurship which is, arguably, reproduced through EE programmes (Ahl and Marlow, 2012; Jones, 2014; Jones and Warhuus, 2018). Finally, the chapter highlights the conspicuous research gap in exploring the possible impact of EECs on STEMM women's perceived gender barriers to entrepreneurship, which in turn may influence their intentions to start a business run by STEMM women (Wheadon and Duval-Couetil, 2018; Wieland *et al.*, 2019).

2.1 Information Collection Process

The following databases were searched for relevant reports, articles, theses, conference papers and peer-reviewed journals in social sciences: Scopus, Web of Science (WoS), Business Source Complete (EBSCO), Google Scholar and

Google Search Engine. All these databases were searched by search strings presented in Table 1 with inclusion criteria depicted in Table 2.

Table 1 Search Strings

Theme	Search Strings
Underrepresentation of STEMM Women Entrepreneurs	1st Row "STEM" or "STEMM" or "SET" or "science" or "technology" or "engineering" or "math" or "medicine" or "high-tech" or "high tech" or "ICT" AND 2nd Row "women" or "female" or "gender" AND 3rd Row "firm" or "entrepreneur" or "business" or "company" or "venture" or "start-up" or "start up" or "startup" or "spin off" or "spin-off" or "incubator" or "incubation"
Entrepreneurship Education and gender	1st Row "entrepreneurship" or "business" or "enterprise" or "entrepreneurial" AND 2nd Row "programme" or "education" or "scheme" AND 3rd Row "feminist" or "feminism" or "women" or "female" or "gender"
Gender Barriers and Entrepreneurship	1st Row "women" or "female" or "gender" AND 2nd Row "barriers" or "career barriers" or "gender barriers" or "challenges" or "difficulties" AND 3rd Row "firm" or "entrepreneur" or "business" or "company" or "venture" or "start-up" or "start up" or "startup" or "spin off" or "spin-off" or "incubator" or "incubation"
Entrepreneurial Intentions and entrepreneurship education	1st Row "entrepreneurship" or "business" or "enterprise" or "entrepreneurial" AND 2nd Row "intentions" or "intention" or "intent" or "interest" AND 3rd Row "programme" or "education" or "scheme"

Table 2 *Inclusion Criteria*

Issue	Inclusion criteria
Publication type	Reports, articles, theses, conference papers and peer-reviewed journals
Language	English
Research discipline	Business, management, science and technology, career and psychology
Research methodology	Descriptive, conceptual, theoretical and empirical
Time period	Up to 2015 with some exceptions for papers related to key theories and constructs

2.2 Neoliberalism and Entrepreneurship Phenomenon

The UK Conservative Party regarded the high unemployment rates experienced in the late 1970s and 1980s (Della-Giusta and King, 2006) as a result of both the former Labour Government's policies and a general lack of enterprise caused by deficits in entrepreneurial attitudes among the population (Lord Young, 1986, cited in MacDonald and Coffield, 1991). Attempting to reduce dependency on state support and enhance enterprise, a neoliberal ideology[1] was introduced by the Conservative Government that embraces a new form of market and logic based on freedom, competition and individuality (Blanchflower and Freeman, 1994). The emphasis on individual choice, agency and personal responsibility (Dodd and Anderson, 2001) encouraged "*the unemployed into self-employment and entrepreneurship*" (Della-Giusta and King, 2006). This created an entrepreneurial culture, individuals with entrepreneurial selves and space for entrepreneurial activity to emerge and expand (Berglund *et al.*, 2018; Scharff, 2016).

Subsequently, building an 'entrepreneurial culture' became a key strategic development of the governments in response to globalisation (EC/EACEA/Eurydice, 2016; Gibb, 2002). The 'enterprise culture' initiative was introduced to influence more dynamic start-up markets and to nurture the growth capabilities of small businesses (SBS, 2004). In addition, the influence of

[1] Neoliberalism is "*a set of economic reforms [….] which are concerned with the deregulation of the economy, the liberalization of trade and industry, and the privatization of state-owned enterprises*" (Steger and Roy, 2010).

neoliberalism resulted in a new identity referred to as the 'entrepreneurial self' in which individuals must work on themselves to compete successfully, achieve their career advancement and be responsible for their own success and failure in lives (Bröckling, 2015; Scharff, 2016). Entrepreneurship has become an alternative career choice for: (a) the unemployed, (b) individuals who seek financial or social rewards from taking risks in entrepreneurship, and (c) women who seek emancipation or independence to achieve a balance between work and family life (Giacomin *et al.*, 2011; Lewis, 2014; Saebi *et al.*, 2019). Consequently, women's entrepreneurship received greater policy attention with the relative enterprise gap being translated into a notional deficit to the national economy (Foss *et al.*, 2018). Women were actively encouraged to start their own businesses, compete in the marketplace, and contribute to economic growth (Berglund *et al.*, 2018; Perren and Dannreuther, 2013).

The entrepreneurship phenomenon has spurred a wider debate in entrepreneurship, which is argued to be very heterogeneous (Gartner, 1988; Welter *et al.*, 2017). Entrepreneurial activities range from high technology sectors to low-income businesses (GEM, 2019; Reynolds *et al.*, 2002). The definitions of *entrepreneurship* and *the entrepreneur* are multi-faceted and have taken on a wide variety of occasionally non-intersecting meanings. Nevertheless, the basic tenets of the notions of risk and uncertainty (Kirzner, 1973) as well as introducing the product or service to the market to attract customers (Schumpeter, 1912) remain as a focal issue in entrepreneurship. This is asserted in a recent definition of entrepreneurship as "*an economic function that is carried out by individuals, entrepreneurs, acting independently or within organizations, to perceive and create new opportunities and to introduce their ideas into the market, under uncertainty, by making decisions about location, product design, resource use, institutions, and reward systems*" (Carlsson *et al.*, 2013, p. 914).

Among all types of entrepreneurship, high-growth firms[2] (HGFs) are recognised as an archetypal business in government policy due to their contribution to employment and wealth generation (Brown and Mason, 2014; Hechavarria *et al.*, 2019). HGFs operate mainly in knowledge-intensive industries, particularly in the STEMM-related sectors (OECD, 2016; de Morais Sarmento and Figueira, 2015). This has raised the governments' expectation towards the contributions of STEMM entrepreneurial activities, particularly research commercialisation and, most recently, entrepreneurship among PhD and post-doctoral students, the so-called *'early career researchers'*[3] (Kochenkova *et al.*, 2016; Muscio and Ramaciotti, 2019). The commercialisation of university research and academic spin-offs has been growing since the late 1980s, yet there is an emerging but overlooked phenomenon of entrepreneurial activities among STEMM ECRs as a potential contributor to economic development (Bienkowska *et al.*, 2016; Muscio and Ramaciotti, 2019). Although neoliberalism has influenced the belief that feminism is obsolete and unnecessary as gender inequality has been solved by the market function itself (Hughes *et al.*, 2017; Kelan, 2009), the underrepresentation of STEMM women within STEMM entrepreneurship remains (NAO, 2018). This points towards the wider structural gender constraints STEMM women are facing (Kuschel *et al.*, 2020; Wheadon and Duval-Couetil, 2018).

2.3 The Leaky Pipeline of Women within STEMM Entrepreneurship

The underrepresentation of women within the STEMM workforce and the shortage of skills related to STEMM entrepreneurship have been identified as one of the key developmental problems (NAO, 2018). Despite the increasing numbers of women entrepreneurs in recent decades, only a small proportion of

[2] High-growth firms are "*enterprises with average annualised growth in the number of employees greater than 20% per year, over a three-year period, and with ten or more employees at the beginning of the observation period*" (OECD, 2017).

[3] According to UK Research and Innovation, early career researchers (ECRs) include students and young professionals within 10 years of starting a PhD (UKRI, 2020).

them are starting businesses within STEMM sectors (Shaw and Hess, 2018). Only 11% of STEMM business owners are women while 33% of women own non-STEMM businesses in the UK (WES, 2018). This is also in line with the "leaky pipeline" phenomenon of women dropping out of STEMM careers, as both employees and business owners (Dasgupta and Stout, 2014). A metaphor is used to describe a dripping pipeline during: (a) childhood or the school years when male stereotypes start to emerge, (b) early adulthood when making decisions to pursue courses in higher education (HE), and (c) in early to mid-adulthood when making career choices and entering the workforce (Wolff *et al.*, 2020). Even though there are both men and women exiting STEMM careers, it is noted that there are considerably more women dropping out than men, resulting in a sex imbalance in the current STEMM fields (Blickenstaff, 2005; Wolff *et al.*, 2020).

The government and social organisations (e.g. Women into Science and Engineering, The Royal Society of Engineering, The National Audit Office) have acknowledged the underrepresentation of women studying and working within STEMM as a part of the serious gender bias issue (CaSE, 2014). To promote careers in STEMM, a series of supportive programmes have been implemented, for example: (1) the re-enter programme (2008-2009) aiming to re-skill and re-train women who want to return to work in STEMM careers, (2) the apprenticeship programmes (2016-2020) offered by the Ministry of Education for STEMM students (HC, 2018), and (3) the integration of entrepreneurial education into STEMM higher education, suggested by The Council of Science and Technology, to promote students' engagement in entrepreneurial activities (QAA, 2018). Nevertheless, only 8% of STEMM apprenticeships were undertaken by girls and women (HC, 2018). This level of sex differentiation in the UK is the lowest when compared to the OECD as a whole (HC, 2018).

Considering the relatively low numbers of women studying, working and running businesses in STEMM, such support programmes indicate limited success. The National Audit Office (2018) concludes that women are still underrepresented in most STEMM subject areas and at every stage within the pipeline. Although the government acknowledges the gender bias within STEMM, the support

programmes do not address the issue effectively. Feminist critiques explain the persistence of the "leaky pipeline" as being: (1) a result of the translation of invisible structural barriers with gender equality contributing to the perpetuated gender disparity within the STEMM society (Hughes *et al.*, 2017) and (2) an indication of the need to investigate the deeply embedded cultural and social cognitive associations that frame STEMM entrepreneurship as masculine concepts and how these ideas affect STEMM women's career interest, progression and retention, particularly within STEMM entrepreneurship (Wheadon and Duval-Couetil, 2018).

2.4 Gendered Assumptions within STEMM Entrepreneurship and Its Education

Despite supportive measures offered by governments and social organisations, the persistent gender gap within STEMM and academic entrepreneurship indicates that our examinations and assumptions of the reasons/factors contributing to gender inequalities for women's participation are insufficient (Wheadon and Duval-Couetil, 2018). The investigation of institutional sexism and structural barriers requires a feminist lens to explore gender implications within the context of STEMM entrepreneurship and its education (Foss *et al.*, 2018). This has raised critiques from feminist scholars regarding the neglected prevalent masculine characteristics within advanced-technology entrepreneurship that encourage women to reproduce masculinised representations of the normative technology entrepreneur (Abreu and Grinevich, 2017; Marlow and McAdam, 2015). Accordingly, this section highlights: (1) how the socially constructed idea of gender has cultivated gender stereotypes framing society's perception towards women as less suitable to pursue successful, high-growth entrepreneurship and (2) how mainstream entrepreneurial education perpetuates this gendered phenomenon (Fine, 2017; Gupta *et al.*, 2019; Jones and Warhuus, 2018).

2.4.1 The Gendered Nature of Entrepreneurship

Within this thesis, the term 'sex' refers to biological sex (male, female); gender is understood as a social construction wherein power is differentially distributed

across social networks, elevating the male and masculine and subordinating the female and feminine (Treanor and Marlow, 2021). Gender consists of various social ascriptions related to stereotypes of masculinities and femininities that are linked to sex categories of men and women (Bowden and Mummery, 2014; Fine, 2017). The association of gender with biological sex has created gender stereotypes which are "*beliefs exaggerate the ability of women in categories in which women are on average more competent than men, while underestimating it in categories where women are on average less competent than men*" (Bordalo *et al.*, 2019, p.3). Given that entrepreneurship was traditionally dominated by men, the stereotypes of a successful entrepreneur are associated with masculine concepts, reinforcing the traditional constructions of the ideal entrepreneur as a heroic male, a maverick and the self-made man (Jones, 2011; Raible and Williams-Middleton, 2021). Accordingly, men entrepreneurs are associated with masculine traits such as being assertive, decisive, dominant, competitive, aggressive, individualistic, ambitious and risk-taking (Ahl, 2004; Marlow and McAdam, 2012).

In contrast, women entrepreneurs are associated with feminine traits such as compassion, gentleness, sympathy, and warmth (Ahl, 2004; Marlow and McAdam, 2012). These stereotypes cause gendered challenges as women and society perceive femininity as less fitting to the entrepreneurial norms (Stead, 2017; Swail and Marlow, 2018). Gender stereotypes create presumptions that women entrepreneurs are different from men entrepreneurs and the differences are articulated by female deficiencies; forcing women to model and imitate "*particular forms of masculinity*" (Hamilton, 2014) in order to gain entrepreneurial legitimacy (Stead, 2017; Swail and Marlow, 2018). Consequently, it is suggested that women who perceive themselves as similar to men tend to demonstrate higher intentions to start a business than those who perceive themselves as less similar to men (Gupta *et al.*, 2009).

Mainstream literature continues to position entrepreneurship as a neutral construct, while the heterogeneity of entrepreneurial activities associates different types of ventures with different gender stereotypes (Gupta *et al.*,

2019). Nevertheless, both men and women associate high-growth and commercial ventures with masculinity, while associating non-growth ventures with femininity (Gupta *et al.*, 2019). In fact, only social ventures are perceived as gender-neutral (Gupta *et al.*, 2019). The association of high-growth and commercial ventures with masculinity indicates that the normative representation of successful entrepreneurship associates the traditional image of an ideal entrepreneur with typical masculine traits and characteristics (Ahl, 2004; Treanor and Marlow, 2021). Women are inherently associated with lower growth and less successful ventures while men are considered as fit for the entrepreneurial career by default (Gupta *et al.*, 2019).

The stereotypes related to high-growth ventures are supported by statistical profiles as women-owned businesses are on average half the size of men-owned businesses, and SMEs that are run by men are five times more likely to reach a turnover of £1 million (Rose, 2019). This thesis argues that stereotypical beliefs act as critical sexist barriers, as they inform assumptions and expectations of who should be what type of entrepreneur (Marlow *et al.*, 2018). Women are pressured to conform to their gender roles that are based on social norms (Eagly *et al.*, 2000). Society, especially women themselves, instantly associate women with less successful or stagnant ventures, while men are associated with more successful or high-growth ones (Gupta *et al.*, 2019). Consequently, women who desire to run high-growth or commercial ventures are implicitly devalued, resulting in women reporting lower self-confidence in their ability to run the types of businesses that are associated predominantly with men (Wieland *et al.*, 2019). This provides entrepreneurial legitimacy to the men as they are positioned as more suitable to become a successful, high-growth entrepreneur (Jones, 2014; Swail and Marlow, 2018).

2.4.2 Gendered Effect and Inequality within STEMM Academic Entrepreneurship

Similar to high-growth entrepreneurship, the stereotypes of advanced-technology sectors are described as ‘masculine’ and associated with white

heterosexual males with obsessive behaviour (Orser *et al.*, 2012), high demands for flexibility/mobility and extensive working hours (Kuschel *et al.*, 2017). Accordingly, women who aim to engage in STEMM entrepreneurial activities are facing stereotypical challenges as they are also perceived as unfit for the normative nature of advanced-technology sectors and successful, high-growth entrepreneurship (Gupta *et al.*, 2019; Wheadon and Duval-Couetil, 2018). Although STEMM women are encouraged to pursue entrepreneurship and engage in research commercialisation, they still engage less in entrepreneurial and commercialisation activities than their male counterparts (Abreu and Grinevich, 2017). Most female academics are more engaged in public and non-profit sectors than in traditional science-based ventures (Abreu and Grinevich, 2017). They are also: (a) less likely to apply for patents, (b) more likely to be involved in research that is less conducive to commercial ventures, (c) hold more junior positions and (d) have less experience in running business (Abreu and Grinevich, 2017).

Among over 6,000 spinout companies from 90 universities worldwide, only 11% of university spinouts are owned by women founders or co-founders (Jarboe *et al.*, 2018). In 2017, women patent inventors worldwide only accounted for 12.7%, which is an increase of 5.9% over the past 20 years (IPO, 2019). Reasons for this include gender disparity, ethical reasons, gender barriers and career constraints (Shaw and Hess, 2018; Wolff *et al.*, 2020). Women's underrepresentation in STEMM fields is one of the factors contributing to the gender gap in STEMM entrepreneurship and research commercialisation (Shaw and Hess, 2018). In addition, women academics are more driven by the projects that create common good and make a social impact (Iffländer *et al.*, 2018), and they feel more ambivalent towards the ethics of the commercialisation process (Murray and Graham, 2007). Some of them experience discriminative behaviours (Bolzani *et al.*, 2021) and stereotypes that portray them as lacking commercialisation skills (Malmström *et al.*, 2017). Work-family conflict (Fox *et al.*, 2011) and less access to start-up capital (British Business Bank, 2019) are

also identified as their challenges to engage in entrepreneurial and commercialisation activities.

The lower performance and interest of STEMM women in research commercialisation and entrepreneurship may suggest that entrepreneurship and training programmes would benefit STEMM women more than their male counterparts (Nowiński *et al.*, 2019; Wilson *et al.*, 2007). Although the proportion of women applying for patents and owning spinout companies has increased, the gender gap within STEMM academic entrepreneurship remains (IPO, 2019). Feminist scholars have explained this gendered phenomenon within STEMM academic entrepreneurship as a result of the structural sexist barriers embedded within not only STEMM entrepreneurship (Kuschel *et al.*, 2020), but also within entrepreneurial education (Jones and Warhuus, 2018). Although it is suggested that enterprise training programmes targeted at reducing sexist beliefs would help reduce gender bias towards women entrepreneurs (Türko, 2016), mainstream entrepreneurship is still perceived and delivered as a neutral construct where the prevailing masculine gender ascriptions are reproduced through entrepreneurial education (Jones and Warhuus, 2018).

2.4.3 Gendered Effect in Entrepreneurial Education

In the quest to promote gender equality within STEMM entrepreneurship, the literature asserts that STEMM ECRs, academics and entrepreneurs have insufficient enterprise knowledge and skills to successfully commercialise their technologies or start-ups (Kochenkova *et al.*, 2016; Rasmussen and Rice, 2012). EE and training programmes were introduced to bridge the entrepreneurial knowledge gap of STEMM researchers and entrepreneurs to increase the effectiveness of commercialisation and knowledge transfer from academia to society (Kochenkova *et al.*, 2016). Although the literature confirms that government support in EE and training significantly enhances knowledge transfer to new and growing businesses at national and regional levels (Sá and Pinho, 2019), the pattern of gender inequalities within STEMM entrepreneurship still persists (Abreu and Grinevich, 2017).

Feminist EE critiques highlight the dominant image of successful entrepreneurs as western and masculine; delivered through EE and its policy (Jones, 2014; Jones and Warhuus, 2018). Entrepreneurs are primarily described in EE policy documents as homogenous with the image of white, western, masculine behaviours, characteristics, mindset and abilities (Jones, 2014). This set of beliefs, attitudes, values and ideas has guided the agenda of EE in HE and shaped social reality constructed around who and what is a successful entrepreneur (Jones, 2014). Consequently, the design of EE course descriptions across the UK and the EU higher education is dominated by masculine language (e.g. innovative, risk-taking, pro-active, competitive, visionary and logical), while feminine language (e.g. collaborative, listening, adaptive, change and opportunities) accounts for only one-third (Jones and Warhuus, 2018).

The dominant image of the ideal, typical entrepreneur in EE policy and the usage of masculine words in EE course descriptions reflect that policymakers and educators may be unaware of, or not sensitive to, the critiques of masculinisation in entrepreneurship and its education (Jones and Warhuus, 2018). The use of dominant masculine language indicates the institutions' reliance on popularised descriptions of entrepreneurship that may perpetuate the structural barriers and legitimacy of women (Jones and Warhuus, 2018; Marlow and McAdam, 2013). In accordance with the image of the ideal entrepreneur, women are also expected to develop this mindset as well as acquire and emulate the skills and behaviours of the ideal entrepreneur (Jones, 2014; Jones and Warhuus, 2018). This perpetuates the assumed benefit of EE as being effective at enhancing women's enterprise knowledge and skills and their participation in STEMM entrepreneurial activities (Jones and Warhuus, 2018).

Subsequently, EE programmes have reported inconclusive results among women. Given EE is found to influence women's intentions to start a business, women who attend EE still demonstrate significantly lower intentions to start a business when compared to men who have never had education in entrepreneurship (Westhead and Solesvik, 2016). Despite EE support, women still find entrepreneurship a less suitable career for themselves when compared

to men (Nowiński *et al.*, 2019). The gendered pattern within EE is particularly visible in the competitive type of EE. As noted by Jones and Warhuus (2018), the intensity of masculine language usage is found to be the highest in the courses that allow students to start real/fictive businesses. Women and men have to compete based on the male prototype of successful entrepreneurs, resulting in decreased self-efficacy and legitimacy of women towards entrepreneurship (Jones and Warhuus, 2018). Nevertheless, the experiential learning is commonly perceived as the most effective and preferable teaching approach among mainstream EE educators and policymakers (Brentnall *et al.*, 2018a; Lackues, 2015; Pittaway and Cope, 2007).

2.5 Enterprise Education Competition: Good or Bad Practice?

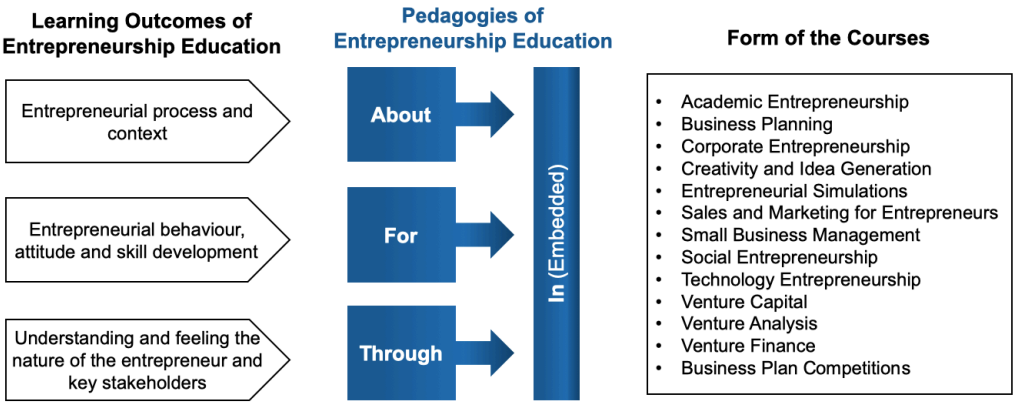
EE has been a central tenet of government policy to support the creation of an enterprise culture and enterprising graduates (EC/EACEA/Eurydice, 2016; QAA, 2018). Entrepreneurship courses have now expanded beyond business schools into knowledge-intensive fields, such as STEMM, in the form of full-time and part-time, short-term and long-term, compulsory and non-compulsory courses, as well as competitions at undergraduate and postgraduate levels (Morris *et al.*, 2013). Teaching "through" entrepreneurship is particularly popular as it encourages experiential learning (Higgins *et al.*, 2019). EECs have become a popular tool – as a good-practice vehicle of EE – to enhance enterprise skills and competencies of individuals (Pocek *et al.*, 2022; Watson *et al.*, 2018). However, EECs in HE are not without critiques (Jones and Warhuus, 2018; Watson and McGowan, 2019; Wegner *et al.*, 2019). This section therefore provides a discussion on: (1) how experiential learning, particularly the EEC, is seen as a good practice among all entrepreneurial pedagogies and (2) how EECs can potentially demotivate women and perpetuate gender inequalities within STEMM entrepreneurship.

2.5.1 Pedagogical Dimensions in Entrepreneurial Education

This thesis defines the term pedagogy as being about the "*interactions between teachers, students and the learning environment and learning tasks*" (Murphy,

2008, cited in Hägg and Gabrielsson, 2019, p.2). According to Pittaway and Edwards (2012), **Figure 1** portrays key entrepreneurial learning outcomes and how they are associated with different pedagogies in EE, namely teaching *about, for*, *through* and *in* entrepreneurship (Gibb, 1987; Pittaway and Edwards, 2012). Teaching "about" entrepreneurship provides fundamental knowledge of the entrepreneurial process and context (e.g. lecturing, textbooks, or video materials). The "for" courses provide tasks, activities and projects for students to acquire key skills and competencies (e.g. business planning and computer simulations). The "through" courses make students learn through some actions of an entrepreneur by starting a business, either real or fictive. The last pedagogy is the "in" approach, which refers to the teaching elements of entrepreneurship in non-business courses.

Figure 1 *Key Learning Outcomes, Pedagogies and Form of Courses in EE (revised from Pittaway and Edwards, 2012)*



Although "about" and "for" courses are most commonly taught in HE, they are not sufficient to cultivate enterprising individuals as they only produce knowledge in regards to the entrepreneurial processes, tools and context (Fayolle and Gailly, 2008; Robinson *et al.*, 2016). To enhance entrepreneurial behaviour, teaching "through" entrepreneurship is an essential teaching approach that connects the conceptual knowledge to entrepreneurial behaviours (Donnellon *et al.*, 2014; Gibb, 1996). This action-based method facilitates learning by doing, reflection upon actions taken, decision-making, logic development, and activity prioritisation. This process allows students to

actively engage in entrepreneurial activities and reflect on the processes and outcomes of the activities (Williams Middleton and Donnellon, 2014).

Therefore, a pedagogy focusing on experiential learning is believed to be the key teaching method in entrepreneurship for students at all levels (Higgins *et al.*, 2019; Neck *et al.*, 2014). When students work in a group setting, they develop entrepreneurial knowledge and skills through interpersonal discussions and decision-making (Lackéus, 2020). The involvement of external networks (e.g. entrepreneurs) allows the students to gain real-life experience and opportunities to develop professional networks for further entrepreneurial development (Lackéus, 2020). The learner centricity emphasises the differences between individuals' knowledge, cognition and creativity resulting in different individuals' learning and opportunity recognition (Corbett, 2005). Among the extensive range of experiential pedagogies, EECs are regarded as a key vehicle for experiential learning in EE (EC/EACEA/Eurydice, 2016).

2.5.2 The Assumed Benefits of Enterprise Education Competitions

In this thesis, enterprise education competitions are defined as experience-based learning activities requiring individuals or teams to develop proposals for products or services (Brentnall *et al.*, 2018a), which are then judged by a group of industrial and investment experts on their commercial merits, with the best individuals or teams being rewarded (Watson *et al.*, 2018). During the EECs, students usually: (1) develop and pitch a product or service through collaboration and competition, (2) learn from reflection and role models[4] and (3) are judged by the competitive process (Brentnall *et al.*, 2018a; Treanor *et al.*, 2021). EECs have been termed business plan competitions (Watson *et al.*, 2018), entrepreneurship competitions (Wegner *et al.*, 2019), entrepreneurship education competitions (Treanor *et al.*, 2021), competition-based entrepreneurship education (Watson and McGowan, 2019) and start-up

[4] Role models is defined as "*individuals whose behaviors, personal styles, and specific attributes are emulated by others*" (Shapiro *et al.*, 1987, p.52 cited in Byrne *et al.*, 2019).

competitions (Passaro *et al.*, 2017) among others. These terms, often used interchangeably, lack defined boundaries. However, business plan competitions typically focus on the development of a traditional type of business plan (Watson and McGowan, 2019). Given that enterprise education[5] aims to help participants "*to generate ideas, the behaviours, attributes, and competences to make them happen*", the term EEC is more accurate (QAA, 2018, p.9).

'EEC' befits the pedagogical design of the YES programme, which is extra-curricular, occurs in industry settings and develops entrepreneurial competencies among participants (Mosey *et al.*, 2005; Treanor *et al.*, 2021) through a variety of sector-focussed learning activities, including: commercialisation workshops, STEMM entrepreneur guest speakers and mini-lectures supported by mentoring sessions to assist translation for pitch development. EECs, typically some variant of a business plan competition, have become a common EE offering, in part due to their promotion within European policy throughout the last decade (EC/EACEA/Eurydice, 2016; QAA, 2018). A number of STEMM business plan competitions, for both real and hypothetical business ideas, have been organised across UK HE, for example, the UK Students Competition, the Young Entrepreneurs Scheme, and the LaunchPad Competition. EECs are said to have become an important part of universities' extra-curricular activities given their benefits in enhancing enterprise-related knowledge and skills (Pocek *et al.*, 2022; Watson *et al.*, 2018) and participants' subsequent entrepreneurial activities (Mann *et al.*, 2017).

However, there are some reports of inconclusive results or limited effects. Wegner *et al.* (2019) found that EECs, delivered as part of a university's push strategies to enhance student entrepreneurial activity, do not significantly impact upon students' intentions to start a business. At school level, EECs have been criticised for reproducing the typical 'middle-class' entrepreneurial norm

[5] Enterprise education is defined as *"the process of developing students in a manner that provides them with an enhanced capacity to generate ideas, and the behaviours, attributes, and competencies to make them happen"* (QAA, 2018, p.9).

and demotivating disadvantaged students who do not perceive they possess the communication skills and confidence sought by competition judges (Brentnall *et al.*, 2018b). This is particularly true for students from lower socio-economic backgrounds who are perceived as, and see themselves as, disadvantaged compared to their peers (Heilbrunn and Almor, 2014). In addition, as the contestants usually associate rewards from the competitions with the best performers as well as to their feelings of self-determination and self-efficacy, students or teams that do not win the competition may perceive themselves as less competent and give up their motivations to engage in entrepreneurial activities (Brentnall *et al.*, 2018b). It is acknowledged that the impact of EECs upon school students and ECRs may differ.

In relation to feminist EE literature, EECs are being critiqued for embracing the competitive nature and neglecting gender bias within EE (Jones and Warhuus, 2018). Given entrepreneurship is largely perceived as gender-neutral, education and training in entrepreneurship is typically delivered in a gender-blind approach. This may unconsciously reproduce masculine norms as behaviours to be role-modelled by participants, given competition formats deploy the greatest intensity of masculine language (Jones and Warhuus, 2018). As competitiveness is deemed a masculine trait (Ahl, 2006), EECs may unintentionally reproduce a masculine norm with similar demotivating effects for participating women in HE. Given that the stereotypical image of a successful high-growth entrepreneur is associated with masculinity (Gupta *et al.*, 2019), STEMM women are expected to acquire the skills and imitate the characteristics of the ideal STEMM entrepreneur (Swail and Marlow, 2018). This potentially demotivates STEMM women who cannot adjust themselves to the competitive nature and the prototype of the male entrepreneur in successful, high-growth ventures (Gupta *et al.*, 2019; Jones and Warhuus, 2018).

While EEC has been successful to some extent, increasing entrepreneurial skills and capabilities based on male stereotypes, evidence suggests that EEC programmes may potentially alienate or reduce the perceived capabilities and self-efficacy of women participants as the winners are modelled on male

stereotypes of entrepreneurs (Jones and Warhuus, 2018). EEC programmes, therefore, can lead to unexpected outcomes that potentially perpetuate a greater disadvantage for women contestants who do not fit into the rules of a game that is defined by specific masculine traits. While EE scholars highlight the competitive type of EE as a critical area that should receive more attention (Higgins *et al.*, 2019), feminist scholars suggest exploring further socio-cognitive factors, such as structural barriers, as potential EE impact measures (Jones and Warhuus, 2018) and critical factors influencing women's intentions to start a business (Laguía *et al.*, 2022).

2.6 Summary

This chapter presents an analytical view of entrepreneurship, women entrepreneurship and EE literature through a feminist lens. It highlights the importance of STEMM women's participation in STEMM entrepreneurial and commercialisation activity (Abreu and Grinevich, 2017); their lack of enterprising skills is identified as a cause for their lower involvement in STEMM entrepreneurial activities (Kochenkova *et al.*, 2016). Despite the government's support, the persistent gender gap prevails (NAO, 2018). This has raised feminist critiques regarding the prevailing masculine gender ascriptions within entrepreneurship (Jones, 2014; Jones and Warhuus, 2018) and the assumed benefits of EE in enhancing women's perceived capabilities and intentions to start a business. This chapter argues that EECs: (1) are implicitly gendered, (2) deliver and reinforce the entrepreneurial masculine stereotypes of an entrepreneur, and (3) expect women to "raise" themselves to the standard of men instead of providing women with the capabilities to overcome the structural barriers (Jones and Warhuus, 2018). Finally, the chapter highlights a conspicuous gap in the research when it comes to exploring the role of socio-economic factors, particularly structural barriers as potential EE impact measures (Jones and Warhuus, 2018) and critical factors influencing women's intentions to start a business (Laguía *et al.*, 2022). The next chapter will provide a deeper investigation into this inquiry through critically analysing the key constructs of this thesis.

3. Perceived Gender Barriers to Entrepreneurship and Entrepreneurial Intentions of STEMM Women

The previous chapter provides a fundamental understanding of literature in entrepreneurship, women entrepreneurship and EE – in regards to the quest into promoting entrepreneurship among STEMM women. It identifies a conspicuous research gap in exploring the role of socio-economic factors, particularly structural barriers, as potential EE impact measures and critical factors influencing STEMM women's intentions to start a business. This chapter provides a deeper investigation into this inquiry by critically analysing the key constructs of this thesis, including: entrepreneurial intentions, entrepreneurial self-efficacy, gender barriers to entrepreneurship and predispositions of EE participants. The chapter begins by introducing entrepreneurial intentions as the main construct of this thesis. Subsequently, the chapter analyses critiques on the dominant intention-based models in entrepreneurship and proposes Social Cognitive Career Theory as an appropriate analytical framework to explore STEMM women's intentions to start a business. Then, the operationalisation of gender barriers to entrepreneurship and predispositions are reviewed and justified as relevant to the objectives of research. Finally, the chapter summarises key research gaps and identifies key factors employed in this thesis to investigate the impact of the EEC programme upon intentions to start a business of STEMM women ECRs.

3.1 Entrepreneurial Intentions

Entrepreneurial intentions (EI) is defined as *"states of mind that direct attention, experience, and action toward a business concept"* (Bird, 1988, p. 442). EI is among the most widely employed constructs used to measure an individual's tendency to commit to entrepreneurial behaviour (Belchior and Lyons, 2022; Santos *et al.*, 2022), and so it is the most prominent impact measure of entrepreneurship courses (Piva and Rovelli, 2021; Wegner *et al.*, 2019). Intention-based models in entrepreneurship have been built upon Bird's (1988)

theoretical framework, suggesting that the intentional process is based on individual attitudes, contextual settings, personal historical factors, personalities and abilities[6]. Nevertheless, the search for appropriate intentions models to predict the tendency of new venture creation is still ongoing. Accordingly, this section: (1) discusses the critiques of the dominant intention-based model employed within the entrepreneurship literature, and (2) proposes a Social Cognitive Career Theory as an appropriate analytical framework to explore EI of STEMM women.

3.1.1 Dominant Intention-Based Models in the Entrepreneurship and Career Literature

Intention-based models offer theoretical frameworks that specifically map out the nature process underlying individuals' planned behaviour to engage in an entrepreneurial activity (Krueger *et al.*, 2000). They provide insights into individuals' decisions to pursue entrepreneurship by explaining how they perceive entrepreneurial opportunities through analysing factors influencing their intentions (Krueger *et al.*, 2000; Shepherd and Krueger, 2002). Intentions models are also widely employed within the career literature to understand the development of an individual's career interests, choices, persistence and performance (Lent *et al.*, 1994, 2000). Given that entrepreneurship and career scholars share similar interests in exploring the development of career intentions, the intention-based models largely employed in both fields are driven by three dominant theories. In the entrepreneurship literature, the foundation of EI theory is often structured around Ajzen's Theory of Planned Behaviour (Ajzen, 1991) and Shapero's Entrepreneurial Event Model (Shapero,

[6] Examples of intention-based models employed within the entrepreneurship literature include Entrepreneurial Event Model (Shapero, 1982), Theory of Planned Behaviour (Ajzen, 1991), Social Career Cognitive Theory (Lent *et al.*, 1994), Krueger's Entrepreneurial Intentions Model (Krueger, 2009), Expectancy Theory (Renko *et al.*, 2012) and Impulsive and Deliberate Entrepreneurial Intentions (Quan, 2012).

1982). Career scholars commonly employ the Social Cognitive Career Theory to explore individuals' career interests (Bandura, 1986; Lent *et al.*, 1994, 2000).

Ajzen's Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) is the most widely applied intentions model within the entrepreneurship literature (Donaldson, 2019; Tornikoski and Maalaoui, 2019). TPB explains the formation of EI through three antecedents: (a) *attitude towards behaviour* is an individual's awareness of the outcome of starting a business and the degree to which the individual perceives venture creation as favourable or unfavourable; (b) *subjective norm* is the positive or negative beliefs of the significant others; and (c) *perceived behavioural control* is the perceived factors that might facilitate or hinder the performance of the behaviour (Ajzen, 1991). In relation to the thesis' inquiry, TPB has been commonly employed by entrepreneurship scholars to explore the influence of EE (Piva and Rovelli, 2021; Wilson *et al.*, 2007) and the role of sex upon EI (Laguía *et al.*, 2022; Shinnar *et al.*, 2014).

Shapero's Entrepreneurial Event (SEE)

Another competing intention-based model within the entrepreneurship literature is Shapero's Entrepreneurial Event Model (SEE) (Krueger *et al.*, 2000; Liguori *et al.*, 2018), through which the development of EI is influenced by three key factors: (a) *perceived desirability* is an individual's perceived attraction to start-up activities; (b) *perceived feasibility* is the degree to which an individual feels personally capable of starting a business; and (c) *propensity to act* is an individual's personal disposition to act on their decisions. Based on Krueger's (2009) analysis, the variables of SEE provide a slightly stronger prediction to EI when compared to those of the TPB. Nevertheless, mainstream entrepreneurship scholars still largely employ TPB as a preliminary model to predict EI.

Lent et al.'s Social Cognitive Career Theory (SCCT)

Social Cognitive Career Theory (SCCT) is a widely applied model within the career literature to explore career/study interest, intentions and behaviour (Lent *et al.*, 1994, 2000, 2018). SCCT examines individual's: (a) career interest development, (b) actual career choice, and (c) stability of performance (Lent *et al.*, 1994). SCCT suggests that career aspirations are influenced by the individual's cognitive variables (e.g. self-efficacy, outcome expectation, and career goals) but also the interaction of personal factors (e.g. biological sex, social supports, and barriers) with environmental influences (e.g. cultural and economic variables) upon individual career aspirations (Lent *et al.*, 1994, 2000). Career scholars employ SCCT to study women's involvement/avoidance in STEMM subjects/careers (Brown and Lent, 2016; Fouad and Santana, 2017). However, entrepreneurship studies employing SCCT to explore EI remain scarce (Liguori *et al.*, 2018; Pfeifer *et al.*, 2016).

3.1.2 Critiques on the Dominant Intention-based Models in the Entrepreneurship Literature

Although TPB and SEE have fulfilled the gap in exploring EI beyond situational and personality factors, there have been questions regarding the consistency and validity of these models (Liguori *et al.*, 2018; Liñán and Fayolle, 2015). First, they are preliminarily conceptualised for individual-level analysis as each model only involves three variables (Dewberry and Jackson, 2018). Although this makes the models simpler and easier to falsify, they are argued to ignore the complexity of social reality, particularly of the influence of contextual factors upon EI (Dewberry and Jackson, 2018; Liguori *et al.*, 2018). This has limited EE scholars to understand deeper cognitive structures and processes underlying EI (Brannback *et al.*, 2007; Pfeifer *et al.*, 2016).

Second, TPB and SEE are argued to be linear models whereas entrepreneurship is a non-linear process (Liguori *et al.*, 2018; Neck and Greene, 2011). The recognition and evaluation of business opportunities can occur before, during, or after an individual decides to start a business (Bhave, 1994). The inclusion of

non-entrepreneurs when studying the entrepreneurship phenomenon also reflects the inherently non-linear nature of entrepreneurship (Katz and Gartner, 1988; Watson, 2013). The unidirectional nature of TPB and SEE has caused difficulties to conduct reciprocal, exponential, and/or moderating relationships (Brannback *et al.*, 2007). For instance, Brannback *et al.* (2006) and Krueger and Kickul (2006) found reverse causation effects between SEE's perceived desirability, feasibility and entrepreneurial intents. In other words, desirability and intent strongly predict feasibility, whereas feasibility almost equally predicts desirability (Brannback *et al.*, 2006).

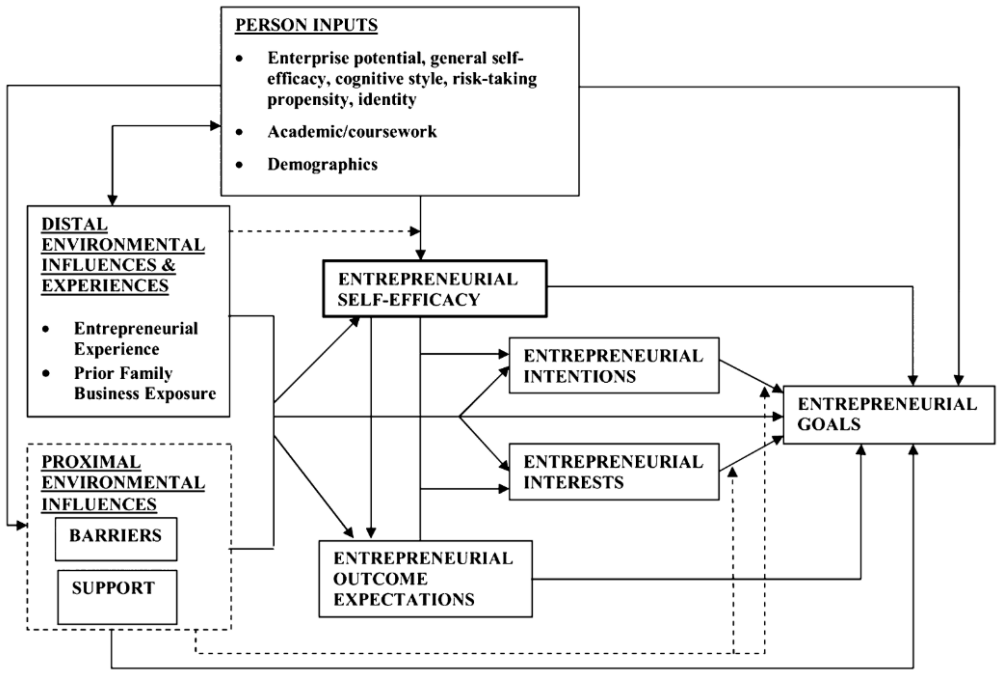
Accordingly, entrepreneurship and EE research employing TPB and SEE models has produced inconclusive results and inconsistent patterns across considerable numbers of variables (Liguori *et al.*, 2018). For example, the relationship between prior family business exposure and EI are supported, partially supported and not supported (Kusumawardani and Albertus, 2020; Turker and Selcuk, 2009; Zellweger *et al.*, 2011). This is partially due to the linear nature and the conceptualisation of TPB and SEE for individual-level analysis (Dewberry and Jackson, 2018; Liguori *et al.*, 2018). Nevertheless, most entrepreneurship scholars still continue to integrate gender-related and contextual factors into these models expecting to better predict EI, for example, barriers to entrepreneurship (Shinnar *et al.*, 2012), gender stereotypes (Laguía *et al.*, 2022) and family business background (Kusumawardani and Albertus, 2020). The critiques on the limitations of the TPB and SEE models have led to calls for alternative theoretical models that provide critical and more complex analysis of factors influencing EI (Donaldson, 2019; Liguori *et al.*, 2018).

3.1.3 Employing Social Career Cognitive Theory to Predict Entrepreneurial Intentions

SCCT is proposed as a suitable theoretical framework for this thesis as it recognises the complexity of social reality and the influence of context upon an individual's career intentions (Belchior and Lyons, 2022), considered particularly relevant to STEMM women (Fouad and Santana, 2017). Unlike TPB and SEE,

SCCT was built on Bandura's (1989) general social cognitive theory with triadic reciprocal causation conceptualised for an expanded range of contextual, personal and behavioural factors (e.g. self-efficacy, social support, goals settings, biological sex and culture). SCCT has been widely employed within the career literature to describe STEMM career development across primary and secondary schools, universities and workplace, particularly of women (Lent *et al.*, 2018; Turner *et al.*, 2019). Nevertheless, there are insufficient entrepreneurship studies utilising the SCCT model to explore an individual's intentions towards new venture creation (Liguori *et al.*, 2018; Pfeifer *et al.*, 2016).

Figure 2 Entrepreneurship Education Project Conceptual Schema Vanevenhoven and Liguori (2013) derived from Lent et al. (1994)



To contextualise the SCCT into this thesis, the Entrepreneurship Education Project Conceptual Schema (Vanevenhoven and Liguori, 2013) – an EE impact model derived from SCCT – is employed to provide a complete overview of the key variables and their relationships, in relation to the scope of this thesis. According to Figure 2, there are two personal factors that are important in regulating EI: (a) *entrepreneurial self-efficacy* and (b) *entrepreneurial outcome expectations.* The concept and definition of entrepreneurial self-efficacy will be

discussed in Section 3.2. Entrepreneurial outcome expectations are the expected outcomes of EE participants. In addition, there are three variables that influence interest formation and translation of career interests into goals: (a) *proximal environmental influences*, which are related to perceived support and barriers to engage in entrepreneurial activities, (b) *person inputs* such as predispositions and biological sex, and (c) *distal environmental influences and experience*, which refers to the previous experience or exposure to entrepreneurship of each individual.

Within this thesis, four key constructs are identified and reconceptualised based on this theoretical model. These constructs include: (a) entrepreneurial intentions, (b) entrepreneurial self-efficacy, (c) perceived gender barriers to entrepreneurship and (d) predispositions. The conceptualisation of entrepreneurial intentions, interest and goals are considered overlapped and are seen wholly as **'entrepreneurial intentions'** in this study (Ajzen, 1991; Krueger, 1993; Lent *et al.*, 1994). **'Entrepreneurial self-efficacy'** is adopted as its original concept. Proximal environmental influences (barriers and support) are reconceptualised as socio-cultural factors – structural barriers, namely **'perceived gender barriers to entrepreneurship'** (Shinnar *et al.*, 2012). Entrepreneurial outcome expectations and distal environmental influences and experience are reconceptualised as **'predispositions'** of EE participants. The following sections explain the theoretical background, justify the relevance and identify gaps in the knowledge of each construct.

3.2 Entrepreneurial Self-Efficacy

Entrepreneurial self-efficacy (ESE) is an individual's perception of their possession of the skills and abilities required to successfully start a business (Bandura, 1986; Wilson *et al.*, 2007). According to Bandura (1997), self-efficacy is influenced by four sources. First, *enactive mastery* is an individual's past performance attainments. Second, *vicarious learning* is when individuals observe how others perform the same or similar tasks. Third, *social persuasion* is positive and negative messages one receives from others about the ability to

achieve a task. Fourth, *emotional arousal* is one's physical and psychological states which impact one's perceptions of their capabilities. ESE can be enhanced through EE and training programmes (Bae *et al.*, 2014; Newman *et al.*, 2019). It is identified as one of the most important determinants of female students' interests to pursue a career in STEMM (Lent *et al.*, 2018).

Scholars have examined the impact of EE on the ESE and EI of women and men. Women from teenagers to adults tend to perceive themselves to have less ability in maths, finance, decision making, risk-taking and problem-solving than their male counterparts (Pfeifer *et al.*, 2016; Wieland *et al.*, 2019). They also perceive they have relatively less ability to pursue careers within male-dominated areas such as STEMM disciplines or entrepreneurship (Wheadon and Duval-Couetil, 2018; Wieland *et al.*, 2019). However, these findings may reflect the influence of socially constructed gender stereotypes (Gupta *et al.*, 2019) relating to 'fit work' for men and women, and the influence of the stereotypical masculinity associated with STEMM entrepreneurship upon STEMM women's careers (Treanor *et al.*, 2021b). Thus, researchers should adopt a gender perspective to identify the influence of sexism/gender barriers on the ESE and EI of STEMM women (Laguía *et al.*, 2022) and explain how structural barriers perpetuate gender inequalities within STEMM entrepreneurship (Kuschel *et al.*, 2020; Wheadon and Duval-Couetil, 2018).

3.3 Perceived Gender Barriers to Entrepreneurship

Gender barriers are described as negative contextual influences that make women's career progress difficult (Lent *et al.*, 2000). Lent *et al.* (2018) posit that perceived barriers negatively influence women's self-efficacy, thereby indirectly influencing their career choices and goals such that, perceived barriers hinder STEMM women's self-efficacy and their decision to pursue STEMM careers. Gender barriers to entrepreneurship are barriers related to women's pursuit of entrepreneurship as a career choice based upon their sex (Wheadon and Duval-Couetil, 2018). Through analysing entrepreneurship and career literature, ten gender barriers to entrepreneurship are identified, including: (1) stereotype

threat, (2) sex discrimination, (3) disapproval by friends and family, (4) lack of role models and mentors, (5) networking difficulty, (6) lack of administrative support, (7) difficulty in obtaining finance, (8) difficulty in identifying stakeholders, (9) childcare-work conflict, and (10) fear of failure.

3.3.1 Stereotype Threat

Although the influence of stereotype threat on engineering women career's interests and choices has been extensively explored, little is known regarding the impact of entrepreneurship courses on negative gender stereotypes towards women's entrepreneurship among female students (Laguía *et al.*, 2022; Wheadon and Duval-Couetil, 2018). Stereotype threat occurs "*when one is in a situation or doing something for which a negative stereotype about one's group applies*" (Steele, 1997, p.614). It acts as a barrier to women entering careers that are not congruent with their biological sex (Türko, 2016). Thus, STEMM women and women entrepreneurs may perceive their gender-incongruent domains as threatening (Cadaret *et al.*, 2017; Wolff *et al.*, 2020). Negative social stereotypes reduce STEMM women's self-efficacy and task performance due to pressure and anxiety that poor performance would confirm the negative stereotypes held towards them with the result that they are distracted and perform to that stereotype (Cadaret *et al.*, 2017; Wolff *et al.*, 2020). Laguía *et al.* (2022) suggest that reducing negative entrepreneurial stereotypes may increase women's EI through enhancing their perceived self-efficacy.

An EE programme specifically designed to counter negative gender stereotypes was shown to be effective in reducing the perceived negative stereotypes held by male and female students towards women's entrepreneurship (Türko, 2016). Türko (2016) found that two deliveries of three-hour workshops – emphasising the women entrepreneurship issue – significantly reduce negative stereotypes of business students towards women entrepreneurs. A long-term intervention programme on career development also increases perceived self-efficacy and reduces perceived negative gender stereotypes among female high-school students (Doren *et al.*, 2013). In addition, the lower perceived masculine

entrepreneurial stereotypes also increase perceived self-efficacy of women towards high-growth entrepreneurship (Sweida and Reichard, 2013) and entrepreneurship in general (Laguía *et al.*, 2022). However, such considerations are not typical of EEC intervention design. Therefore, an EEC programme may reinforce the stereotype threat for women participants in this context. Although stereotype threat is widely employed to investigate its influence on STEMM women career's interest and choice goals, career scholars largely neglect STEMM entrepreneurship as a career choice of STEMM women (Cadaret *et al.*, 2017; Wolff *et al.*, 2020).

3.3.2 Sex Discrimination

Sex discrimination is widely studied within the career literature to explain its influence on STEMM education/career interest, retention and termination of female college and university students (Hughes *et al.*, 2017; Turner *et al.*, 2019; Watts *et al.*, 2015). It is the perceived financial impact and climate of an entrepreneurial career as discriminated against their biological sex (Swanson and Tokar, 1991). Sex discrimination is influenced by: (a) the implicit masculine gender bias within a particular context and (b) the assumptions of inclusivity and individualism in the neoliberal society (Ahl, 2004; Kelan, 2009; Poutanen and Kovalainen, 2017). Women are assumed to start, experience and advance in their education and careers with similar levels of resources to men, while they actually face structural barriers that put them in disadvantaged positions (Ahl, 2004; Byrne *et al.*, 2019; Hardin and Longhurst, 2016). STEMM women and women entrepreneurs experience sex discrimination within and outside their workplace – such as sexual harassment, balancing domestic responsibilities and work, inferior treatment, and negative social cues/comments from their peers (Cadaret *et al.*, 2017; Cochran, 2019; Treanor and Marlow, 2021).

STEMM women PhD and post-doctoral students are facing sex discrimination which affects their career-related self-efficacy and intentions (Hughes *et al.*, 2017; Watts *et al.*, 2015). They experience inappropriate sexual comments, double standards, and gender-political games within their working environment

(Hytti, 2003; Moss-Racusin *et al.*, 2012). These perceptual and behavioural discriminations make it difficult for women to advance in their career, leaving them with feelings of isolation, less sense of belonging and a lack of belief that they can work or run a business in a male-dominated environment (Cadaret *et al.*, 2017; Cochran, 2019; Milli *et al.*, 2016; Wolff *et al.*, 2020). However, there is a limited number of entrepreneurship studies that: (a) investigate sex discrimination as a potential determinant of women's EI and (b) explore the influence of EE programmes on perceived sex discrimination in STEMM entrepreneurship (Wheadon and Duval-Couetil, 2018).

3.3.3 Disapproval by Friends and Family

Social support strongly influences one's career choice (Greene *et al.*, 2013). Their peers provide a sense of belonging and encourage them to pursue their career aspirations (Greene *et al.*, 2013). Family and friends provide significant emotional and social support that enables one's perceived ability on their roles in their respective career (Eddleston and Powell, 2012; Greenhaus and Allen, 2011). When considering a career path, women consider and receive social support from their family, friends and, sometimes, significant others – such as career advisors or PhD supervisors (Jensen and Schøtt, 2017). In the US, female entrepreneurship students find their relationships with their peers and family members important to their entrepreneurial career goals (Cochran, 2019). STEMM female post-doctoral students finds their relationship with supervisors important for their decisions to pursue a career in physics and astronomy and to complete their post-doctoral degree (Ivie *et al.*, 2016). Support from friends and family reduces perceived risk and increases EI of women in the fields that are not congruent to their biological sex (Wieland *et al.*, 2019).

3.3.4 Lack of Role Models and Mentors

A lack of women role models and mentors is a commonly identified problem for STEMM women considering careers in STEMM entrepreneurship (Kuschel *et al.*, 2017; Neumeyer, 2020). Role models symbolise that entrepreneurial success is possible and can motivate young people to engage in entrepreneurial activities

(Byrne *et al.*, 2019). Women role models help women confront stereotypes by providing information, guidance, and support that is significant for women's decisions to pursue non-traditional careers (Austin and Nauta, 2016). They can influence personal attitude, self-efficacy, perceived social support and career intentions (Austin and Nauta, 2016; BarNir *et al.*, 2011). Although role models influence ESE and, in turn, the EI of men and women (Nowiński and Haddoud, 2019), this impact is stronger for women than for men (BarNir *et al.*, 2011). However, women role models may potentially increase awareness among female students of women's underrepresentation and discrimination against women scientists (Breda *et al.*, 2018). Some entrepreneurial women role models may have a negative motivational effect if they portray themselves as heroic superwomen, denying the existence of gender barriers and portraying entrepreneurship as an easy way for working mothers to balance childcare and work responsibilities (Byrne *et al.*, 2019).

Mentoring is identified as a primary means to resolve career challenges of women in high-technology sectors and is highly related to career advancement of STEMM women (Orser *et al.*, 2012). Mentors are experienced entrepreneurs who provide private support and impart wisdom of values to their mentees (Rose, 2019). Mentoring regarding career support helps women advance in their career more than their male counterparts (Theranou, 2005). Several studies assert the positive effect of mentoring support on career-related self-efficacy of women entrepreneurs and STEMM women (GEM, 2017; Orser *et al.*, 2012). Canadian women who work within the high-technology sectors suggest mentoring programme as a key measure to cope with the gender gap within the industry (Orser *et al.*, 2012). In addition, a peer mentor is found to serve as a familiar role model for entrepreneurship students (Kubberød *et al.*, 2018). However, there are insufficient studies that: (a) explore the impact of EE programmes on perceived mentoring support among STEMM women and (b) investigate how perceived mentoring support influences their EI (Sweida and Reichard, 2013).

3.3.5 Networking Difficulty

Entrepreneurial network may include "*friends, family members, colleagues, other entrepreneurs, customers, employees, or investors who can provide the entrepreneur with access to resources and competences that may be valuable to found her/his venture and make it grow*" (Piva and Rovelli, 2021, p.4). STEMM women and women entrepreneurs face a challenge in developing and utilising their professional network contacts within a commercial masculine-dominated environment (Kuschel *et al.*, 2020) such as incubators (Marlow and McAdam, 2012), technology transfer offices (Giuri et al. 2018), and venture capital and entrepreneurial financing (Alsos *et al.*, 2006; Edelman *et al.*, 2018). STEM women graduates are more reluctant than their male counterparts to leverage their university network contacts; this has been identified as a key factor attributing to sex-imbalance in entrepreneurial entry (Piva and Rovelli, 2021). Similarly, women scientists perceive less sense of belonging and are less likely to develop mixed-sex professional networks (Cheryan *et al.*, 2017). An eight-month gender-sensitive EE programme offering experiential learning and peer mentoring is found to enhance entrepreneurial networks of entrepreneurial women engineers (Elliott *et al.*, 2020). However, there are insufficient studies exploring the influence of a generic EE programme on perceived difficulty in networking among STEMM women.

3.3.6 Lack of Administrative Support

Scholars identify the lack of administrative support as an important resource-related barrier (Shinnar *et al.*, 2012). Administrative support has been identified as one of the key challenges for those wanting to pursue entrepreneurial opportunities (OECD, 2016; Shinnar *et al.*, 2012). This includes administrative support throughout the starting-up process – for example, fiscal charge, accounting, assistance in assessing business viability, formal help to start a business, and legal assistance or counselling (Giacomin *et al.*, 2011; Shinnar *et al.*, 2012). Female university students in China, the US, and Belgium significantly perceive the lack of administrative support as more important than men do

(Shinnar *et al.*, 2012). The lack of administrative support is also identified as a key barrier to entrepreneurship for Spanish, Chinese, and Belgium students (Giacomin *et al.*, 2011). Given that the lack of administrative support is an important barrier to EI of university students (Giacomin *et al.*, 2011; Shinnar *et al.*, 2012), there is no evidence of a study investigating the impact of EE programmes on perceived administrative support, particularly within the context of STEMM entrepreneurship.

3.3.7 Difficulty in Obtaining Finance

Based on the traditional view of entrepreneurship, women entrepreneurs have been associated with small, part-time or home-based businesses (Marlow and McAdam, 2013). This has shaped the structural stereotypes of women to risk avoidance and, in turn, has limited the demand for offering such support, particularly in business funding (Marlow and Swail, 2014). In addition, the providers of financial resources are also found to make decisions based on partial information and are vulnerable to the influence of gendered stereotypes (Malmström *et al.*, 2017). In effect, women entrepreneurs operating their businesses in male-dominated industries tend to receive less support in obtaining finance (Marlow and Swail, 2014). The lack of support in obtaining finance is found to have a negative effect on EI among Chinese students (Shinnar *et al.*, 2012). Piva and Rovelli (2021) posit that an EE programme can increase STEMM women graduates' probability of engaging in an entrepreneurial activity through providing understanding in entrepreneurial finance.

3.3.8 Difficulty in Identifying Stakeholders

Starting a business requires engagement with stakeholders including investors, co-founders, employees, business network, suppliers and customers. Identifying stakeholders are seen as constraints of women entrepreneurs. Attracting co-founders and staff members are identified as barriers for nascent entrepreneurs (Mergemeier *et al.*, 2018). In India, investors still perceive a woman entrepreneur as another co-founder of the start-up (Manshani and Dubey, 2017). Canadian women entrepreneurs are reluctant to stretch their contracts

to acquire large clients and supplier opportunities (Orser *et al.*, 2012). Acknowledging that promoting supplier diversity can address inequities in the marketplace and enhance growth of potential women entrepreneurs in the supply chain (OECD, 2014), women entrepreneurs find it more difficult to build a client base and business network (Marlow and Swail, 2014). However, little is known about how STEMM women perceive these barriers and how they influence their ESE and EI. It is also unclear how EE programmes would affect this relationship.

3.3.9 Childcare-Work Conflict

Childcare responsibilities are a key structural barrier for the female workforce (Ahl and Marlow, 2012; Treanor and Marlow, 2021). Employers and business partners prefer STEMM male professionals, with female counterparts being discriminated against due to potential future maternity (Bolzani *et al.*, 2021). STEMM women are forced to rely on their partners' support, income and predictable work schedules to cope with childcare responsibilities (Marlow and McAdam, 2012). Consequently, STEMM women have a binary choice: (a) being a sole caretaker of the family and compromising their careers, or (b) outsourcing the caretaking role to their partners or childminders and foregoing the childcare opportunity (Marlow and McAdam, 2012). Treanor (2019) found that young STEMM academic researchers perceived this 'maternity threat' as a potential barrier to academic STEMM career progression and, consequentially, some participated in EE to learn about STEMM entrepreneurship and alternative career options.

3.3.10 Fear of Failure

Most scholars assert that fear of failure acts as a barrier to entrepreneurship (Cacciotti *et al.*, 2016; Shinnar *et al.*, 2012). Fear of failure is examined as a psychological factor that inhibits entrepreneurial behaviour. In some cases, fear of failure is found to demotivate an individual's EI (Morgan and Sisak, 2016). In addition, women's risk aversion and fear of failure are also used to explain low growth rates and entrepreneurial propensity in their own businesses (Langowitz

and Minniti, 2007). In the United States and Belgium, female students perceive fear of failure as a more important barrier to start a business than their male counterparts (Shinnar *et al.*, 2012). Although women, in general, tend to be more risk-averse than men, Wieland *et al.* (2019) argue that there is no difference between men and women perceiving risk when controlling for age, education, and entrepreneurial experience. Nevertheless, there is a consensus that men and women are more likely to take more risks in the domains that are congruent to their sex (Wieland *et al.*, 2019). Some entrepreneurship courses are found to increase students' perceived risk towards entrepreneurship (Efrata *et al.*, 2021; Westhead and Solesvik, 2016) and may encourage students who perceived higher risk to become more realistic regarding an entrepreneurial career (Oosterbeek *et al.*, 2010).

Table 3 Literature Landscape of Perceived Gender Barriers to Entrepreneurship, Entrepreneurial Education and Entrepreneurial Intentions

Perceived gender barriers to entrepreneurship	Influence of EE upon gender barrier	Their Influence upon EI
Stereotype threat	Türko (2016)	Laguía *et al.* (2022)
Sex discrimination	-	Marlow and McAdam (2012)
Disapproval by significant others	-	Wieland *et al.* (2019)
Lack of role models and mentors	Kubberød *et al.* (2018)	Nowiński and Haddoud (2019)
Networking difficulty	Elliott *et al.* (2020)	Piva and Rovelli (2021)
Lack of administrative support	-	Shinnar *et al.* (2012)
Difficulty in obtaining finance	Piva and Rovelli (2021)	Shinnar *et al.* (2012)
Difficulty in identifying stakeholders	-	Shinnar *et al.* (2012)
Childcare-work conflict	-	Treanor (2019)
Fear of failure	Efrata *et al.* (2021)	Shinnar *et al.* (2012)

Referring to Table 3, EE scholars have, to some extent, studied the influence of EE programmes on several aspects related to perceived barriers in stereotype threat (Türko, 2016), the lack of role models and mentors (Kubberød *et al.*, 2018), networking difficulty (Elliott *et al.*, 2020) and difficulty in obtaining finance (Piva and Rovelli, 2021). Conversely, little is known about the impact of EE programmes upon most of the perceived gender barriers proposed in this thesis. Within the entrepreneurship literature, it is evident that most of these barriers are found to influence EI. However, none of the studies have investigated the particular impact of EEC upon these perceived gender barriers

despite the increasing acknowledgement regarding the embedded masculine gender bias, particularly within EECs (Jones and Warhuus, 2018) and gendered learning experience (Kubberød *et al.*, 2021).

3.4 Predisposition Levels

Within EE and career literature, individual and contextual factors are found to influence an individual's learning experience in a training programme (Lent *et al.*, 1994, 2000; Liñán *et al.*, 2018). Among these factors, EE scholars have paid particular attention to predispositions of EE participants prior to their EE participation (Bae *et al.*, 2014; Liñán *et al.*, 2018). Researchers have recognised the possible self-selection bias of EE participants who attend extracurricular/non-compulsory EE courses prior to which they may have acquired some level of predispositions towards entrepreneurship (Fayolle and Gailly, 2015; Liñán *et al.*, 2018). These predispositions include: (1) pre-education entrepreneurial intentions, (2) prior entrepreneurial exposure, and (3) prior entrepreneurial motivation. These three predispositions are asserted to cause EE programmes to have a diverse impact upon certain groups of participants (Liñán *et al.*, 2018; Westhead and Solesvik, 2016). The following sections will discuss each of them in turn.

3.4.1 Pre-Education Entrepreneurial Intentions

Pre-education entrepreneurial intentions (Pre-EI) are the level of EI that students have developed before attending the EE programmes (Bae *et al.*, 2014; Liñán *et al.*, 2018). Early EE scholars argue that students who want to become an entrepreneur are more likely to demonstrate higher Pre-EI and decide to pursue an entrepreneurship major (Noel, 2002). Students with high interest in entrepreneurship are also more likely to attend EE extra-curricular activities for personal interest and development (Bae *et al.*, 2014; Liñán *et al.*, 2018). Many scholars have termed this as a "self-selection bias" adding difficulty to the evaluation of EE programmes (Liñán, 2004; Liñán *et al.*, 2018). Given that there are insufficient EE impact studies that encompass Pre-EI into their research, controlling for self-selection bias when evaluating EE programmes is seen as

essential and, arguably, necessary for future EE studies (Bae *et al.*, 2014; Liñán *et al.*, 2018).

3.4.2 Prior Entrepreneurial Exposure

Prior entrepreneurial exposure is found to influence Pre-EI of EE participants (Fayolle and Gailly, 2015; Liñán *et al.*, 2018). An individual gains prior entrepreneurial exposure through their personal history related to entrepreneurship, including: (1) belonging to a family of entrepreneurs, (2) having been involved in student organisations, (3) experience in living abroad, or (4) having taken part in a prior EE training programme (Fayolle and Gailly, 2015; Peterman and Kennedy, 2003; Zellweger *et al.*, 2011). Krueger (1993) firstly introduced the breadth of business experiences as a potential determinant to an individual's attitude towards entrepreneurship. Specifically, positive business experience is suggested to influence a more positive attitude towards entrepreneurship than bad experiences would (Krueger, 1993; Kusumawardani and Albertus, 2020). However, Zellweger *et al.* (2011) argue that negative prior family business exposure can lower a student's interest in pursuing an entrepreneurial career. Specifically, being exposed to the constraints in family business and personal sacrifices imposed on their parents is one of the reasons students decide against an entrepreneurial career to avoid the responsibilities and pressures related to entrepreneurship (Zellweger *et al.*, 2011).

Prior entrepreneurial exposure has been employed to investigate its influence upon the impact of EE programmes (Fayolle and Gailly, 2015; Nabi *et al.*, 2017). Fayolle and Gailly (2015) found that the EE impact is stronger for students who have little or no prior entrepreneurial exposure. However, there are insufficient studies exploring the influence of prior entrepreneurial exposure on Pre-EI which indirectly influence the impact of EE programmes (Liguori *et al.*, 2018; Zapkau *et al.*, 2015). Although entrepreneurship scholars posit the significant influence of prior entrepreneurial exposure on an individual's EI, most EE studies have produced inconclusive and, in some cases, conflicting results (Zapkau *et al.*,

2015). This is due to the reliance of EE scholars on employing direct (intention-based) models such as TPB and SEE as they: (1) simplify the relationship between prior entrepreneurial exposure and EI, (2) ignore the complexity of EI development and (3) neglect the important role of Pre-EI impact upon Post-EI (Liñán *et al.*, 2018; Zapkau *et al.*, 2015). Therefore, EE scholars are encouraged to investigate the impact of prior entrepreneurial exposure on Post-EI through employing an indirect (intention-based) model such as SCCT to reduce the inconclusive findings from employing the direct (intention-based) models such as TPB and SEE (Zapkau *et al.*, 2015).

3.4.3 Prior Entrepreneurial Motivation

Women's intentions to start a business can be triggered by two major sources of motivation. The first is 'push' or 'necessity' motivation, which occurs when women perceive limitations, barriers and disadvantages in their traditional careers that influence them to consider an entrepreneurial career path (Byrne *et al.*, 2019; Laguía *et al.*, 2022). Women entrepreneurs and scientists face several barriers such as sex discrimination, gendered assumptions (Marlow and McAdam, 2015; Treanor and Marlow, 2021), 'glass ceiling,' 'maternal wall' (Thébaud, 2015), demanding childcare responsibilities (Jayawarna *et al.*, 2013) and stigma associating them with maternal role and caring responsibilities (Bolzani *et al.*, 2021; Cadaret *et al.*, 2017). These barriers, in turn, influence STEMM women's search for independency and job flexibility (Foley *et al.*, 2018; Kuschel *et al.*, 2020). In addition, women tend to report lower positive attitude towards entrepreneurship and are more likely to start a business out of necessity (Laguía *et al.*, 2022). They tend to have a different start-up motivation and approach to entrepreneurship (Kuschel *et al.*, 2017) towards a home-based business (Jayawarna *et al.*, 2013) or small enterprise for personal profit and value with more sensitivity to loss and risk (Marlow and Swail, 2014).

The second form of motivation, 'pull' or 'opportunity', is the motive to start a business that is not driven by necessity or structural barriers (Elam *et al.*, 2019) but generally driven by the pursuit of profit, social impact and/or personal

challenges (Dawson and Henley, 2012; Giacomin *et al.*, 2011). Some EE scholars have explored the 'pull' motivation of students further, dividing it into *intrinsic* and *extrinsic* motivation. Intrinsic motivation refers to *"a personal interest in the entrepreneurial task"* and extrinsic motivation *"relates to an external reward associated, but not exclusively, to such task"* (Belchior and Lyons, 2022, p. 153). Intrinsic motivation (to gain entrepreneurial and ownership experience) is found to be the most relevant to student's EI, followed by the motivation to have meaningful social contribution, power and status, a particular occupational interest and to be independent, respectively (Belchior and Lyons, 2022). In the context of STEMM EE, female STEMM students enrol in an engineering entrepreneurship course because they would like to: (1) become a global professional, (2) make a difference and (3) apply theory learned in school to address a problem (Dzombak *et al.*, 2016). Despite women reporting general motivation to participate in EE programmes, feminist scholars have noted that women tend to perceive push and pull motivation as an intertwined concept that cannot be clearly separated (Jayawarna *et al.*, 2013; Welter *et al.*, 2017). However, there is insufficient research adopting a gender perspective in exploring entrepreneurial motivation of female students (Belchior and Lyons, 2022; Laguía *et al.*, 2022), particularly within the context of EE and STEMM entrepreneurship.

3.5 Summary

This chapter provides a critical analysis of the key constructs of this thesis, including: (1) entrepreneurial intentions (EI), (2) entrepreneurial self-efficacy (ESE), (3) perceived gender barriers to entrepreneurship and (4) predisposition of EE participants. Four key gaps in research have been identified. First, there are calls for alternative theoretical models that provide critical and more complex analysis of factors influencing EI (Donaldson, 2019; Liguori *et al.*, 2018). Second, there is a necessity to explore the influence of sexism/gender barriers on the ESE and EI of STEMM women (Laguía *et al.*, 2022). Third, there is a potential gap in research exploring EE impact, particularly that of EEC programmes, upon perceived gender barriers to entrepreneurship (Jones and

Warhuus, 2018). Fourth, there is insufficient research adopting a gender perspective in exploring entrepreneurial motivation of women students (Belchior and Lyons, 2022), particularly within the context of EE and STEMM entrepreneurship.

Accordingly, the following research question is proposed: "To what extent does the EEC, as a vehicle of EE, influence perceived gender barriers to entrepreneurship, ESE and in turn EI of STEMM women ECRs?" The objectives of the research are:

1) To investigate the extent to which the EEC programme impacts perceived gender barriers to entrepreneurship, ESE and EI of STEMM women ECRs;
2) To investigate to what extent perceived gender barriers to entrepreneurship influence ESE and EI of STEMM women ECRs, and;
3) To investigate to what extent the potential impact of the EEC programme is influenced by individual predispositions.

To answer this research question, this chapter proposes SCCT as an appropriate analytical framework to explore STEMM women's EI. The chapter also identifies ten gender barriers to entrepreneurship and three predispositions of EE participants, as critical factors for EE research. The next chapter will analyse empirical evidence to identify the relationships between each construct to develop the hypotheses of the thesis.

4. Research Hypotheses

The previous chapter offers an extensive analysis of the thesis' key constructs and identifies key gaps in the research, which subsequently informs the development of the research questions and objectives. In addition, the SCCT has been proposed as an appropriate theoretical model in exploring the EEC impact upon EI of STEMM women ECRs. Building on the conceptualisation of SCCT, this chapter predicts the relationships between the EEC programme and each key construct to formulate the analytical framework to investigate the impact of the EEC programme upon perceived gender barriers to entrepreneurship, ESE and EI of EEC participants. The research hypotheses are structured around the three research objectives: (1) investigating the EEC impact upon perceived gender barriers to entrepreneurship, ESE and EI; (2) investigating the influence of perceived gender barriers to entrepreneurship on ESE and EI; and (3) investigating the influence of individual predispositions upon the EEC impact. Finally, the chapter proposes a hypothesised model conceptualising the EEC impact upon perceived gender barriers to entrepreneurship, ESE and EI of EEC participants.

4.1 Investigating the EEC Impact upon Perceived Gender Barriers to Entrepreneurship, ESE and EI

EE programmes can enhance EI of students through improving students' ESE (Nabi *et al.*, 2017; Nowiński *et al.*, 2019). In particular, EEC programmes are found to enhance enterprise-related knowledge and skills (Pocek *et al.*, 2022; Watson *et al.*, 2018) and participants' subsequent entrepreneurial activities (Mann *et al.*, 2017). However, not all types of EE programmes yield positive results. Kassean *et al.* (2015) posit that engaging in more experiential activities enhances EI but reduces ESE of non-entrepreneurship students. Vanevenhoven and Liguori (2013) found no correlation between participating in extracurricular activities and any core variables of the SCCT. Arranz *et al.* (2017) posit that extracurricular activities lower perceived competencies and EI of Spanish undergraduate students. Wegner *et al.* (2019) found that EECs, delivered as part

of a university's push strategies to enhance student entrepreneurial activity, do not significantly impact students' EI.

However, there is a notion that women are affected by EE differently from men (Kickul and Griffiths, 2009; Nowiński *et al.*, 2019). Women still report significantly less EI than men before and after attending the EE programmes (Westhead and Solesvik, 2016). Although they perceive higher ESE and EI following EE attendance, they still demonstrate less ESE and EI when compared to their male counterparts (Nowiński *et al.*, 2019; Wilson *et al.*, 2007). This is aligned with the critiques regarding the potential role of EECs in demotivating disadvantaged school students who do not possess the communication skills and confidence sought by competition judges (Brentnall *et al.*, 2018b). In addition, this is consistent with the feminist critiques on the competitive type of EE for potentially demotivates STEMM women who cannot adjust themselves to the competitive nature and the prototype of the male entrepreneur (Jones and Warhuus, 2018). Accordingly, it is predicted that women STEMM ECRs will perceive lower EI and ESE before and after attending the competition.

> H1: Following EEC attendance, STEMM women ECRs demonstrate lower EI than their male counterparts.

> H2: Following EEC attendance, STEMM women ECRs demonstrate lower ESE than their male counterparts.

The limited effects of EE upon women and the persisting gender pattern within STEMM entrepreneurship have raised feminist critiques regarding the necessity to explore gender barriers to entrepreneurship as potential EE impact measures (Jones and Warhuus, 2018). Evidently, EE programmes are suggested to provide STEMM women with knowledge on entrepreneurial finance (Piva and Rovelli, 2021). Gender-sensitive EE programmes are found to reduce negative stereotypes towards women entrepreneurs among students (Türko, 2016) and provide access to entrepreneurial networks for entrepreneurial women engineers (Elliott *et al.*, 2020). A peer mentoring EE programme is found to provide familiar entrepreneurial role models for university students (Kubberød

et al., 2018). However, EE programmes can also negatively impact perceived barriers related to risk and fear of failure among students towards entrepreneurship (Efrata *et al.*, 2021; Langowitz and Minniti, 2007). These conflicting findings indicate two competing arguments that the EEC programme may yield diverse results among STEMM women ECRs in relation to perceived gender barriers to entrepreneurship. Accordingly, the hypotheses are:

H3: Prior to EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts.

H4a: Following EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts.

H4b: Following EEC attendance, STEMM women ECRs perceive lower gender barriers to entrepreneurship than their male counterparts.

4.2 Investigating the Influence of Perceived Gender Barriers to Entrepreneurship on ESE and EI

Within the career literature, perceived barriers are found to hinder STEMM women's self-efficacy and their decision to pursue STEMM careers (Lent *et al.*, 2018). Within the entrepreneurship literature, perceived barriers are posited to influence ESE and EI of students, women entrepreneurs and STEMM women (Laguía *et al.*, 2022; Shinnar *et al.*, 2012; Sweida and Reichard, 2013). For example, fear of failure is found to influence EI of female students more than their male counterparts (Shinnar *et al.*, 2012). Perceived negative or gender-incongruent entrepreneurial stereotypes can undermine women's perception of their ESE and EI in such domains (Laguía *et al.*, 2022; Wieland *et al.*, 2019). The lower perceived masculine entrepreneurial stereotypes also increase perceived ESE of women towards high-growth entrepreneurship (Sweida and Reichard, 2013) and entrepreneurship in general (Laguía *et al.*, 2022). In addition, STEMM women PhD and post-doctoral students are facing sex discrimination which affects their career-related self-efficacy and intentions (Hughes *et al.*, 2017; Watts *et al.*, 2015). All other perceived gender barriers to entrepreneurship

identified in this thesis are shown to have an impact upon women's perceived self-efficacy and intentions to pursue a career in the domains that are incongruent to their sex. This is also likely to apply to the masculine-dominated fields such as STEMM entrepreneurship. Accordingly, it is predicted that perceived gender barriers to entrepreneurship will influence ESE and, in turn, EI of STEMM women ECRs.

> H5: ESE mediates the relationship between gender barriers to entrepreneurship and EI of STEMM women ECRs.

4.3 Investigating the Influence of Individual Predispositions upon the EEC Impact

EE scholars are suggested to consider the possibility of self-selection bias among students who select themselves for EE programmes, as they may have acquired some level of predisposition which in turn may result in skewed findings (Fayolle and Gailly, 2015; Liñán *et al.*, 2018). These predispositions include prior entrepreneurial intentions (Pre-EI) and prior entrepreneurial exposure. It is found that students with high interest in entrepreneurship are also more likely to attend EE extra-curricular activities for personal interest and development (Bae *et al.*, 2014; Liñán *et al.*, 2018). Consequently, the high level of Pre-EI may result in insignificant change in EI among these students following EE attendance (Bae *et al.*, 2014).

Prior entrepreneurial exposure has been found to produce mixed effects upon EE impact. Westhead and Solesvik (2016) assert that students from self-employment ownership backgrounds report significantly higher EI following EE attendance, whereas Fayolle and Gailly (2015) posit a negative effect of EE upon EI of students who have had prior EE exposure. In some cases, prior entrepreneurial exposure influences a higher level of Pre-EI of students, which may influence diverse outcomes of the EE programmes (Liñán *et al.*, 2018). Accordingly, it is predicted that STEMM women ECRs with prior entrepreneurial exposure will report high Pre-EI. Consequently, there will be less room to increase their EI and, therefore, their high level of Pre-EI would reduce the

impact of the EEC programme (Bae *et al.*, 2014; Fayolle and Gailly, 2015). Accordingly, the following hypotheses are proposed:

H6: Following EEC attendance, participants with high Pre-EI demonstrate insignificant change in EI.

H7a: Prior entrepreneurial exposure positively influences Pre-EI of EEC participants.

H7b: Following EEC attendance, participants with prior entrepreneurial exposure demonstrate insignificant change in EI.

H8: The higher the level of entrepreneurial motivation, the higher the level of Pre-EI of EEC participants.

4.4 Formulating the Hypothesised Model

Table 4 provides the list of seven research hypotheses in accordance with the objectives of research.

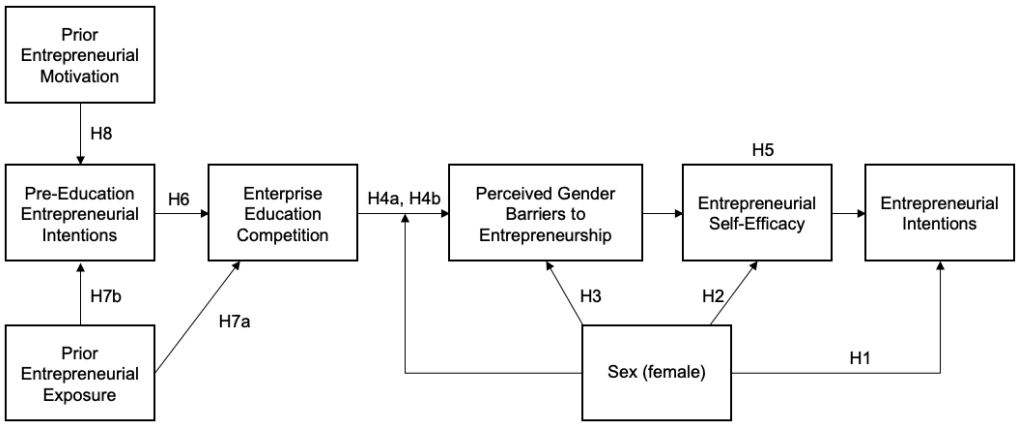
Table 4 Research Objectives and Hypotheses

Objective 1: To investigate the extent to which the EEC programme impacts perceived gender barriers to entrepreneurship, ESE and EI of STEMM women ECRs	
H1	Following EEC attendance, STEMM women ECRs demonstrate lower EI than their male counterparts.
H2	Following EEC attendance, STEMM women ECRs demonstrate lower ESE than their male counterparts.
H3	Prior to EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts.
H4a	Following EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts.
H4b	Following EEC attendance, STEMM women ECRs perceive lower gender barriers to entrepreneurship than their male counterparts.
Objective 2: To investigate to what extent perceived gender barriers to entrepreneurship influence ESE and EI of STEMM women ECRs	
H5	ESE mediates the relationship between gender barriers to entrepreneurship and EI of STEMM women ECRs.
Objective 3: To investigate to what extent the potential impact of the EEC programme is influenced by individual predispositions	

H6	Following EEC attendance, participants with high Pre-EI demonstrate insignificant change in EI.
H7a	Prior entrepreneurial exposure positively influences Pre-EI of EEC participants.
H7b	Following EEC attendance, participants with prior entrepreneurial exposure demonstrate insignificant change in EI.
H8	The higher the level of entrepreneurial motivation, the higher the level of Pre-EI of EEC participants.

Following the theory and hypothesis development, the proposed analytical model is presented in **Figure 3** with arrows representing hypothesised paths. The hypothesised model proposes the competing arguments that the EEC programme can either increase or decrease perceived gender barriers to entrepreneurship of women participants. The perceived gender barriers to entrepreneurship are predicted to mediate the relationship between ESE and, in turn, EI of women participants. In addition, women participants are expected to demonstrate a higher level of perceived gender barriers to entrepreneurship and a lower level of ESE and EI when compared to their male counterparts before and after attending the EEC programme. It is predicted that women participants with high Pre-EI will also report high EI following the competition. Prior entrepreneurial exposure is predicted to positively influence Pre-EI of women participants.

Figure 3 Hypothesised Model



4.5 Summary

This chapter identifies seven research hypotheses which have been used to formulate the analytical model for the quantitative analysis. The chapter provides an analysis of empirical evidence from the literature review to predict the relationships between the EEC programme and each key construct. The chapter then proposes the analytical framework to investigate the impact of the EEC programme upon perceived gender barriers to entrepreneurship, ESE and EI of EEC participants. This thesis proposes a set of two competing hypotheses, that the EEC programme will have a positive and/or negative influence upon perceived gender barriers to entrepreneurship. It is predicted that perceived gender barriers to entrepreneurship will influence the ESE and, in turn, EI of EEC participants. In addition, this thesis has acknowledged the potential influence of Pre-EI and prior entrepreneurial exposure upon the EEC impact. The hypothesised model provides a novel theoretical framework in exploring the EEC impact upon EEC participants, particularly of women. The next chapter will provide an analysis of philosophical assumptions underlying this thesis and details regarding research methods and strategy.

5. Research Methodology

The previous chapter presented the hypotheses and conceptual framework formulated to investigate the impact of the EEC programme on perceived barriers to entrepreneurship, ESE and EI of STEMM women ECRs in comparison to men. This chapter outlines the critical realist philosophy underlying the mixed methods approach (QUAN → Qual) employed in this thesis to answer the research question: "*To what extent does the enterprise education competition (EEC) as a vehicle of entrepreneurial education (EE) influence perceived gender barriers to entrepreneurship, ESE and in turn EI of STEMM women early career researchers (ECRs)?*". The chapter begins by providing the rationale for adopting a critical realist approach through analysing the ontological, epistemological and methodological debates underlying the quantitative-qualitative approaches. Subsequently, it discusses how a critical realist approach advances our understanding of the influence of gender and EEC impact. Then, the detailed research strategy (QUAN → Qual) is outlined. Finally, the limitations and ethical considerations of the study are discussed.

5.1 Critical Realism, Entrepreneurial Education and Gender

This section outlines the rationale for adopting a critical realist approach in this research. The section begins by discussing the conflict, incommensurability and incompatibility theses of the dominant positivist and interpretivist approaches to entrepreneurship research. Subsequently, mixed-methods research under a critical realist stance is argued to be a suitable tool that offers complementarity and resolves the limitations of the two competing ontologies. Next, the critical realist perspective is discussed as a philosophical standpoint that will reflect a more realistic account of gender and the EE phenomena. Finally, the section summarises the researcher's critical realist position within this thesis and

proposes Explanatory Sequential Design (QUAN → Qual), a two-process mixed-methods approach,[7] as the research methodology.

5.1.1 The Paradigms in Entrepreneurship Research

The paradigms in the entrepreneurship literature are underlain by the clusters of interrelated philosophical assumptions, namely (a) ***ontology***, which is the branch of philosophical assumptions about the nature of reality which shapes the way researchers see the world and their approaches to their research; and (b) ***epistemology***, which is the way a researcher believes in what constitutes acceptable, valid and legitimate knowledge and how they communicate this knowledge (Burrell and Morgan, 1979). A researcher's ontological assumptions guide and underlie their position regarding epistemology (Bazeley, 2018). The two main ontological approaches employed in entrepreneurship research are positivism and interpretivism. ***Positivism*** views reality as objective and independent (Long *et al.*, 2000). A positivist ontology is associated with a realist epistemology and quantitative methods. Positivists employ deductive reasoning relying on hypothesis testing, large samples and statistical research designs (Howe, 1988). In contrast, an ***interpretivist*** ontology is associated with a social constructionist epistemology and qualitative research methods. Interpretivists view reality as embedded within individual's own experiences and therefore regard realities as multiple and subjective (Saunders *et al.*, 2016). Social constructionists employ inductive reasoning relying largely on qualitative methods whereby the researcher's observations and judgement influence the conclusions (Ketokivi and Mantere, 2010).

The long debates of the two opposing paradigms are centred around arguments of 'incommensurability' and 'incompatibility'; a perspective advocating that

[7] In this study, mixed-methods research is defined as "*the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g. use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration*" (Johnson *et al.*, 2007).

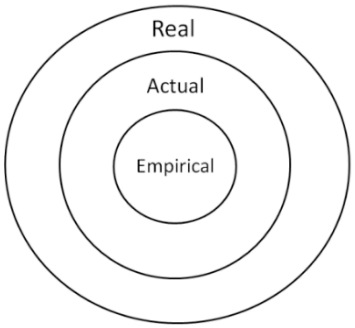
quantitative and qualitative approaches should not be and could not be applied in the same study (Howe, 1988; Smith and Heshusius, 1986). Mainstream entrepreneurship research often follows a positivist approach where the observers are seen as separated from the subjects of the social observations (Karatas-Ozkan *et al.*, 2014) from which the results and knowledge are justified by reliability, validity and statistical significance (Watson, 2013). In contrast, social constructionists argue that multiple realities abound and that the observer and the subjects studied cannot be separated as the observer is the only source of reality (Guba, 1990). The prevailing argument has shed the light on post-positivist, critical realist approach which has drawn upon mixed methods for the 'complementarity' between qualitative and quantitative approaches by seeking "*elaboration, illustration, enhancement, and clarification of the results from one method with findings from the other method*" (Molina-Azorín *et al.*, 2012). The next section will introduce critical realism, which has drawn upon mixed-methods research, to explain how this approach offers 'complementarity' to the current ontological debates between interpretivism and positivism.

5.1.2 Critical Realism and Mixed-Methods Research

In response to the incommensurability and incompatibility theses, scholars have adopted a critical realist perspective to bridge the gap between positivism and interpretivism (Mingers, 2004). Critical realism (CR) embodies realist ontology with a constructionist epistemology (Maxwell and Mittapalli, 2010). The realist ontology emphasises that reality largely exists and operates independently of our awareness and knowledge of it (Archer *et al.*, 1998; Bhaskar, 2008). The generation of knowledge is socially constructed through our individual standpoints and perceptions (Creswell and Plano Clark, 2018). In other words, reality can depend upon various specific details of its production processes, for example, theories, methods, and research techniques, employed by researchers at a certain time and place (Zachariadis *et al.*, 2013). Given its ontological realism (underlain by scientific realism supporting positivist research), CR allows for a degree of social constructionism where individuals' partial experience and their interactions contribute to the conceptualisation of knowledge and reality (Jen,

2019; Lindgren and Packendorff, 2009). Accordingly, CR is perceived to be ontologically and epistemologically "compatible" with quantitative and qualitative research (Clark *et al.*, 2007; Shannon-Baker, 2016).

Figure 4 *Domains of the Real, Actual, and Empirical (Depth)*



Apart from the ontological and epistemological compatibility, CR offers a mode of analysis called 'retroduction' (Bhaskar, 2008) that supports the validity and quality of inferences of mixed-methods research (Zachariadis *et al.*, 2013). Referring to **Figure 4**, CR assumes a stratified ontology encompassing three layers of reality (depth), namely, *'real, actual and empirical'* (Archer, 2007; Gorski, 2013). The *empirical* reality is our experiences of what happens in the world. The *actual* reality contains all the events that happen in the world which we do and do not experience. The *real* consists of structures or mechanisms which exist independently from our experiences and the events they may or may not generate (Shipway, 2011; Thorpe, 2019). The mechanisms are believed to transcend our experience of the reality, regardless as to whether or not the mechanisms are realised, actualised or perceived (Bhaskar, 2008). Accordingly, CR allows mixed-methods researchers to infer causalities between context-based relationships and particular situations (Shannon-Baker, 2016) as they are able to "*move between the knowledge of empirical phenomena… to the creation of explanations in ways that hold 'ontological depth' and can potentially give some indications on the existence of unobservable entities"* (Zachariadis *et al.*, 2013, p. 858). Therefore, the critical realist movement reinforces the justification for researchers to adopt mixed-methods as a distinctive approach to understand more fully the phenomena as it allows the researchers to answer

multidimensional questions, for instance: “What works for all EE participants?”, “What works for women?”, “What does not work for women?” and “Why?” (Jen, 2019; Thorpe, 2019). The next section justifies why CR is believed to help overcome paradigms in feminist research in relation to the context of this thesis.

5.1.3 Critical Realism and Gender Studies

Even though feminist research has extensively drawn attention from scholars, practitioners and policymakers in relation to structural gender inequalities (Foss *et al.*, 2018), the heterogeneity of women’s voice and experience is still underrepresented within the feminist discourse (Martinez Dy *et al.*, 2014; Wimalasena, 2017). The three dominant philosophical assumptions underlying feminist research are under critiques (Foss *et al.*, 2018). These philosophical strands include Feminist Empiricism (FE), Feminist Standpoint Theory (FST)[8] and Feminist Post-Structuralism (FPS)[9]. FE follows positivist ontology and empiricist epistemology viewing men and women as explanatory variables and assumes equal capacities between them; hence, neglecting feminist inquiry regarding the invisible structural barriers women are facing (Ahl, 2006; Harding, 1986). Even though FST emphasises women’s experience and their ‘subjugated knowledge,’ this perspective faces its ontological and epistemological conflict as it tries to enhance research objectivity through the experience of women as a collective group (New, 2020). Accordingly, marginalised women (e.g. black, lesbian, or working-class women) are still ignored and the discourse is dominated by the voice of ‘white, professional, straight women’ (Heckman, 1997; New, 2020). FPS, on the other hand, is criticised for understating the influence of structures on masculine domination (New, 2020).

[8] Feminist Standpoint Theory (FST) is a feminist epistemological strand that views knowledge as partial and socially situated (Haraway, 1988). The aim of FST research is to “*make women’s unique perspectives and contributions visible*.” (Foss *et al.*, 2018)

[9] Feminist Post-Structuralism (FPS) “*defines gender as socially constructed through history, geography and culture*”. The aim of FPS research is to “*make gendered discriminatory practices visible*.” (Foss *et al.*, 2018)

A critical realist approach can play a critical role towards feminist inquiry as it perceives diverse perspectives, viewpoints and voices as important to the research process (Modell, 2009). CR provides multidimensional realities particularly when researchers conceptualise gender. It agrees that gender is a social construction as the social world is constructed through the interactions individuals have with others (Archer, 2000). Individuals make sense of gender based on their own feelings and actions as well as by conceptualising their own needs, capacities and the resources around them (New, 2020). Archer (2000) views this process as 'inner conversation' between individuals' responses and others' responses, which creates further situations for individuals to respond to. This interaction between agents and structures influences individuals' aspiration or deficiency for change in the gender order (New, 2020). By accepting realist ontology and social constructionist epistemology as well as emphasising the relationship between agents and mechanisms, CR is argued to be a robust alternative to the current streams of philosophical assumptions within gender studies (Gunnarsson *et al.*, 2016).

To create effective change through feminist research, it is necessary to understand the relevant causal mechanisms as much as possible at all levels of reality and the relationships between them (New, 2020). Through a critical realist lens, perceived gender barriers can be seen as independently pre-existing barriers and social interpreted meanings. Giving childcare-work conflict as an example, it is factual that: (1) females are the only sex that can give birth and (2) they are required to take some time off work to recover from birth and may also do so to provide primary care (e.g. breastfeeding) to their children. However, women may or may not perceive this as a barrier to entrepreneurship. They also may consciously or unconsciously reflect on the given barrier after attending an EE programme. In other words, a woman might perceive childcare to be a barrier to entrepreneurship, making this an *Empirical* Reality. Even if she does not report that the availability of affordable childcare influenced her career decision, it may still have had an influence as part of the *Actual* Reality. Finally, the *Real* might include social expectations that women should act as the primary carer

with legal frameworks supporting this assumption. From this conceptualisation, CR offers this thesis the opportunity to develop a deeper understanding of how women perceived gender barriers by trying to understand not only "What women think?" but also "What influences their perception?" and "Why?" The following section will discuss how this thesis intends to employ a critical realist stance to enhance the accuracy and deeper understanding of the gendered phenomena within EE research.

5.1.4 Critical Realist Analysis of Outcomes of Entrepreneurial Education

Mainstream EE studies are largely influenced by positivist ontology which promotes feminist empiricist assumptions that men and women are fundamentally equal and that women are deficit and therefore will benefit from EEs more than men (Foss *et al.*, 2018). However, the positivist approach to EE studies is being criticised for its lack of accuracy and ability to produce in-depth outcomes (Jones and Warhuus, 2018). EE programmes are found to produce mixed, inconsistent and inconclusive results among women (Nowiński *et al.*, 2019; Westhead and Solesvik, 2016). Even though women demonstrate higher change in perceived ESE and EI than their male counterparts after attending EE programmes, they still possess lower rates of ESE and EI because they started from a much lower basepoint (Nowiński *et al.*, 2019; Westhead and Solesvik, 2016). These findings have led to the mainstream assumption that women tend to benefit from EEs more than men (Nowiński *et al.*, 2019; Wilson *et al.*, 2007). Such studies are argued to neglect structural gender bias which influences women's perceived ESE and EI before, during and after attending EE programmes (Jones and Warhuus, 2018). They also assume the homogeneous effect of EE programmes on women presuming that all women share the same experience and are influenced by such programmes in the same way (Marlow, 2014; Pritchard *et al.*, 2019). This perpetuates the assumption that EE programmes are effective to enhance women's ESE and EI, without questioning the underlying structural problem; leading to biased and elusive implications and implementations of EE policy (Jones and Warhuus, 2018).

Feminist researchers have employed a social constructionist approach to challenge the assumed benefits and biased implications of positivist EE research; however, research following a social constructionist stance encompasses its own limitations. Through employing qualitative methods, research reveals that there is the dominant western, masculine image of the ideal entrepreneur within EE and its curriculum that perpetuates structural barriers and legitimacy of female students (Jones and Warhuus, 2018; Marlow and McAdam, 2013). Despite researchers exploring diverse experiences of EE participants, studies investigating EE's impact solely on and between women remain scarce (Mosey *et al.*, 2005; Treanor, Noke, *et al.*, 2021). Even though the social constructionist approach to some extent successfully highlights the heterogeneity of participants' experience as well as the tension between the mechanism (structural gender bias) and agents (women), their findings cannot be used to directly explain the causal relationships from EE positivist studies which remain unanswered. The limitations of the positivist and interpretivist approaches in producing synchronous results and enquiries for practitioners and policymakers have shed light on CR as an alternative approach to the implications for EE and gender theories.

Subsequently, CR has increasingly been adopted to evaluate the effectiveness of educational programmes (Jen, 2019; Thorpe, 2019). Brentnall *et al.* (2018b) questioned the assumed benefits of EEC programmes in enhancing young people's entrepreneurial motivation and self-efficacy by employing a realist evaluation lens towards EE evaluation (Pawson, 2013). They viewed EE programmes as 'complex social programmes' because "*they are socially mediated; they are delivered by people with varying levels of organization and autonomy; they have many moving parts; and they operate in larger, multilevel communities with multiple agendas and actors that may directly or indirectly influence the functioning of the programme and its outcomes*" (Brentnall *et al.*, 2018b; Chatterji, 2016). It was argued that such complex programmes cannot be sufficiently evaluated by the mainstream scientific evaluation methods (e.g. quasi-experiment) due to the fact that *"complex, socially contingent*

interventions will always have different effects on different participants in different circumstances" (Brentnall *et al.*, 2018b). Through this assumption, they intended to answer not only "What works for EE participants?" but also "In what circumstances?" and "Why?" Their study remarkably revealed benefits and drawbacks of EEC programmes, particularly their negative effects on disadvantaged students from lower socioeconomic background (Brentnall *et al.*, 2018b). Therefore, CR offers an opportunity for EE researchers to produce richer EE implications for policymakers and practitioners about what might work, for whom and why (Pawson and Manzano-Santaella, 2012; Rideout and Gray, 2013).

5.1.5 Applying Critical Realism in My Research

Aiming to evaluate the effectiveness of the EEC programme, this thesis adopts a critical realist perspective to answer the overarching research question: "*To what extent does the enterprise education competition (EEC) as a vehicle of entrepreneurial education (EE) influence perceived gender barriers to entrepreneurship, entrepreneurial self-efficacy (ESE), and in turn entrepreneurial intentions (EI) of STEMM women early career researchers (ECRs)?*" Influenced by the study of Brentnall *et al.* (2018b), the thesis views EEC as a complex social programme, the outcomes of which are influenced by: (a) various elements and the environment of the programme (contextual nature of the phenomena), (b) people involved in the programme, and (c) their influence on each other as a complex social process (interactions between agents and structures). The selected term 'to what extent' in the research question implies a critical realist approach to the thesis' enquiries because employing CR will provide suggestive/indicative but fallible outcomes based on the results from this study instead of suggesting a generalised and universal answer. The research question cannot be answered solely through positivist nor social constructionist stances as the latter does not support causal relationships while the former does not recognise multiple constructed realities which are unjustifiable by the mainstream scientific methods (Jen, 2019). Therefore, the thesis intends to investigate the contextual phenomenon through exploring gender as both a variable and disaggregated data: (a) to measure the impact of the EEC

programme on perceived gender barriers to entrepreneurship, ESE and EI of women participants in comparison to their male counterparts, (b) to ascertain which parts of the programme influenced ESE, perceived gender barriers to entrepreneurship and EI of the women participants, and (c) to elaborate how these parts possibly influence different groups of the women participants.

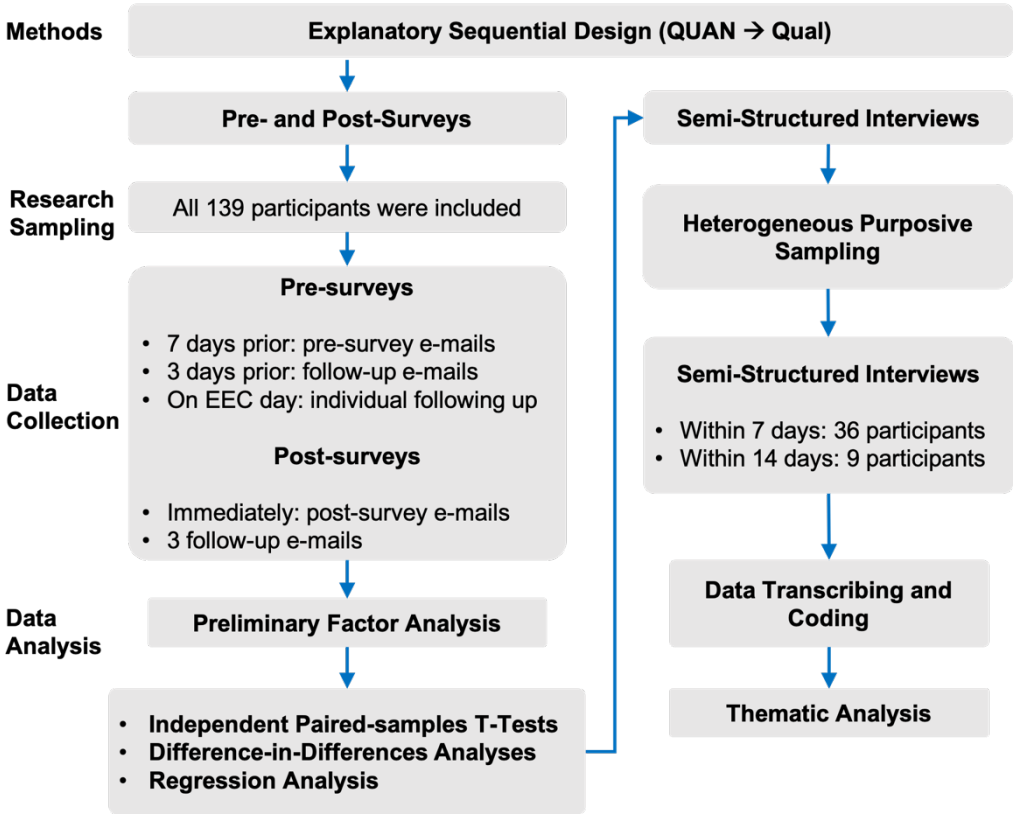
5.2 Mixed-Methods Research: Explanatory Sequential Design (QUAN → Qual)

This thesis employed a two-process mixed-methods approach, specifically Explanatory Sequential Design (QUAN → Qual), to achieve the critical realist aim of investigating the impact of the EEC programme on perceived gender barriers to entrepreneurship, ESE and EI of women participants. Explanatory Sequential Design is the most common type of mixed-methods employed within the EE literature through longitudinal questionnaires followed by semi-structured or focus group interviews (Crammond, 2018; Montes-Martínez, R. Ramírez-Montoya, 2020; Olukundun, 2017). Explanatory Sequential Design is "*a mixed methods design in which the researcher begins by conducting a quantitative phase and follows up on specific results with a subsequent qualitative phase to help explain the quantitative results*" (Creswell and Plano Clark, 2018, p. 133). The 'QUAN → Qual' symbol indicates that the thesis initially conducted the quantitative study followed by the qualitative study. While the quantitative study measured the EEC impact on women participants and highlights possible relevant gender implications, the qualitative study explored the heterogeneity of women participants' experience (Creswell and Plano Clark, 2018). **Figure 5** provides the diagram of the research process adopted in this thesis.

According to **Figure 5,** the study primarily employed deductive and subsequently inductive modes of analysis to explore the studied gendered phenomenon. Initially, the quantitative approach was conducted through pre- and post-surveys to: (1) test the relationships between attending the EEC programme, perceived gender barriers to entrepreneurship, ESE and EI of men and women participants as well as (2) to suggest possible gender implications/outcomes produced by the EEC programme. Subsequently, these possible gender

implications arisen from the quantitative results were used to provide the scope of the qualitative analysis (Creswell and Plano Clark, 2018). The qualitative approach was employed through semi-structured interviews which were then coded, transcribed and analysed by the thematic analysis (Hammersley, 1996; Henry *et al.*, 2015) to establish the heterogeneity of women participants' experience (Creswell and Plano Clark, 2018).

Figure 5 *Research Process Diagram*

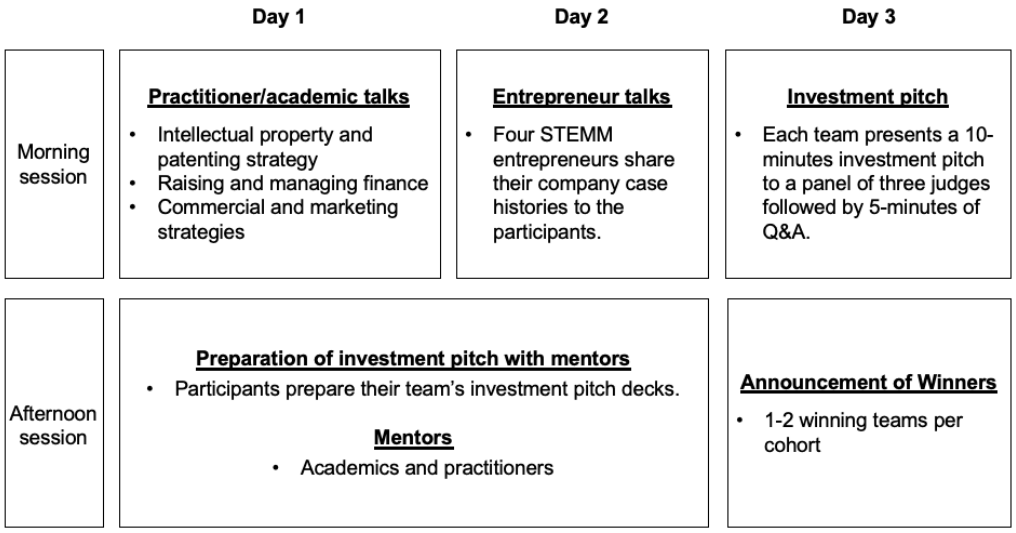


5.3 Research Setting

The Young Entrepreneur Scheme (YES) 2019 is the focal EEC of this study. The programme was founded in 1995 through the collaboration of the University of Nottingham, Institute of Enterprise and Innovation (UNIEI) and the Biotechnology and Biological Sciences Research Council (BBSRC) (Webb, 2010). It is one of the first university-based, short-term, non-compulsory EE programme aimed at developing the commercial awareness and communication skillset of the STEMM ECRs across UK universities (Mosey *et al.*, 2012). By 2022, there had been over 6,300 STEMM ECRs that had participated

in the YES Competition with a ratio of 53 to 47 women to men participants. YES 2019 was delivered as a series of three-day workshops for cohorts of 139 STEMM ECRs under three themes: (a) biotechnology, (b) engineering, and (c) environment. The pedagogical design of YES 2019 is aligned with teaching 'through' entrepreneurship encompassing experiential learning (Pittaway and Thorpe, 2012; Watson *et al.*, 2018). The YES programme was found to: (1) increase the chances of STEMM ECRs working outside academia, (2) foster entrepreneurial competencies among participants and (3) enhance participants' tendency to engage in commercialisation and entrepreneurial activity (Mosey *et al.*, 2012; Treanor, Noke, *et al.*, 2021). The competition format is summarised in Figure 6.

Figure 6 Structure of the YES Programme



Referring to Figure 6, the first two mornings of the competition consisted of talks from STEMM entrepreneurs, academics and practitioners regarding commercialisation strategies and STEMM company case studies; during afternoon sessions, participating STEMM ECRs collaborated within their self-selected teams of four to five members to prepare an investment pitch, availing of mentoring sessions with business advisors, IP lawyers and investors. On the final day, participants presented their 10-minute investment pitch for their hypothetical-but-plausible business to a panel of three judges, followed by a 15-minute question-and-answer session. At the end of each competition round, two

winning teams per cohort were selected to advance to the national final. Winning teams received non-financial awards including a company visit, BioIndustry Association gala dinner tickets and online training worth £800 per person.

In addition, the competition was promoted through public STEMM institutions (e.g. UKRI, BBSRC), STEMM university departments and intellectual property and knowledge transfer offices across UK universities. A series of workshops on creativity and idea generation were delivered online to prepare participants pre-competition. Investment pitches included: product summary, market analysis, strategy overviews re: product, R&D, logistics, marketing and patenting, management team, financial forecast, and investment proposal. Investment pitches were adjudged based upon: (a) structure and presentation of the proposal and feasibility of: (b) R&D and IP strategy, (c) commercial and marketing strategy and (d) financial plans. The panel of three judges comprised industrial and investment experts. The subsequent section will elaborate how this thesis collected and analysed the quantitative data from YES 2019.

5.4 Research Methods: Quantitative Study

Following the Explanatory Sequential Design (QUAN → Qual) research strategy, this section primarily discusses the quantitative research methods employed to answer the research question: "*To what extent does the enterprise education competition (EEC) as a vehicle of entrepreneurial education (EE) influence perceived gender barriers to entrepreneurship, entrepreneurial self-efficacy (ESE) and in turn entrepreneurial intentions (EI) of STEMM women early career researchers (ECRs)?*" The key aim of the quantitative study is to test the research hypotheses and to suggest possible gender implications arisen from the quantitative findings which further guided the scope of the subsequent qualitative analysis. The section begins by justifying the sufficiency of using the YES 2019's participants as the research population of the quantitative study. Subsequently, the section discusses the quantitative measures employed in the surveys, outlines the survey distribution process and summarises the response

rate of the surveys distributed. Finally, the section provides details of the statistical analysis conducted to test the hypotheses of research.

5.4.1 Research Population

The research population identified in this study are the STEMM women and men ECRs who participated in the YES Competition 2019. Researchers evaluating the impact of EE typically employ no sampling strategy; rather, they include in their sample as many women and men participating in specific programmes as possible to maximise sample size (Fayolle and Gailly, 2015; Piperopoulos and Dimov, 2015). This thesis also adopts this nonprobability sampling method and therefore the results of this study cannot be viewed as representative of the UK population (Wilson *et al.*, 2007). The quantitative study compares men and women participants who self-selected into the YES 2019 programme. Therefore, men participants acted as the control group for women participants with inferences drawn relating to the impact of the EEC upon women participants, similar to the approach adopted in the extant literature (Fayolle and Gailly, 2015; Nowiński *et al.*, 2019).

5.4.2 Data Collection and Response Rate

A total of 139 STEMM women and men ECRs participated in the YES Competition 2019 from which the thesis requires a minimum of 93 respondents – who complete both pre- and post-surveys – to represent 0.95 confidence level with 5% of marginal error (Saunders *et al.*, 2016). It was reported that most of EE studies received a minimum response rate of 75% (Nowiński *et al.*, 2019; Westhead and Solesvik, 2016). Therefore, a minimum response rate of 75% is expected. This translates into a minimum of 105 respondents who complete both pre- and post-surveys.

This thesis achieved 87% complete response rate, equating to 120 respondents, which is considered sufficient to represent a 0.95 confidence level with 5% of marginal error. Before data collection, seven men and women STEMM PhD students were asked to complete pilot surveys to test for clarity; minor

amendments were made based on feedback. Ethical approval was obtained before the fieldwork commenced. As presented in the Research Process Diagram (**Figure 5, Page 64**), the final surveys were electronically distributed, using Qualtrics™, to the YES 2019 participant database by the YES Coordinator, in line with GDPR guidelines. Pre-surveys were distributed seven days before each competition round, followed by a reminder email four days later. On the first morning of each competition round, participants who had not completed the online pre-competition surveys were provided with printed surveys for completion; these were then coded into Qualtrics™. Post-surveys were distributed immediately after each competition with up to three follow-up e-mails issued, where necessary, to boost response rates. All of these activities contributed to 87% response rate – exceeding the expected response rate by 12%. **Table 5** summarises the response rate breakdown by each YES Competition 2019 cohort.

Table 5 *Pre- and Post-Surveys Response Rate*

Survey Respondents	Cohort #1	Cohort #2	Cohort #3	Total
Total Participants	30	59	50	**139**
Completed Pre- and Post-Surveys	27	55	39	**120**
Completed Response Rate	90%	93%	78%	**87%**
Expected Response Rate	75%	75%	75%	**75%**
Expected/Response Rate Difference	+15%	+18%	+3%	**+12%**

5.4.3 Design of Pre- and Post-Surveys

All construct measures employed in the pre- and post-surveys were adopted from existing scales. All items, apart from prior entrepreneurial exposure and demographic information, were measured using a five-point Likert scale. The sources and explanations of the employed measures are summarised in **Table 6**. The final pre- and post-surveys are attached in **Appendix A** and **Appendix B.**

Table 6 *Sources and Explanations of the Employed Construct Measures*

Construct	Source	Measures and Explanation
Entrepreneurial Intentions	(Mosey *et al.*, 2005, 2012a; Wilson *et al.*, 2007a)	Likelihood to pursue the careers in: (a) industrial research, (b) academic research, (c) industrial management, (d) university management, (e) own company, (f) government and (g) other.
Entrepreneurial Self-Efficacy	(Lucas *et al.*, 2009; Lucas and Cooper, 2004; Piperopoulos and Dimov, 2015)	Confidence in the following commercialisation skills: (a) start-up financial evaluation, (b) marketing, (c) supplier management, (d) cost estimation, (e) business idea evaluation, (f) recruitment and (g) customer persuasion.
Perceived Gender Barriers to Entrepreneurship	(Giacomin *et al.*, 2011a; Spencer, 1993; Swanson and Tokar, 1991b, 1991a)	Perceived likelihood to encounter the following barriers to entrepreneurship: (a) sex discrimination, (b) discouragement from STEMM career pursuits, (c) disapproval by significant others, (d) conflict between childcare and demands, (e) difficulties in networking and socialisation, (f) stereotype threat, and (g) lack of support in entrepreneurship.
Prior Entrepreneurial Exposure	(Fayolle and Gailly, 2015; Krueger, 1993a; Pfeifer *et al.*, 2016a)	The breadth of entrepreneurial experience in: (a) having family and close friends as entrepreneurs, (b) working for a small or new company, (c) starting their own businesses, and (d) prior entrepreneurial education.
Entrepreneurial Motivation to Participation	(Giacomin *et al.*, 2011a)	Motivation to participate in the EEC programme: (a) becoming an entrepreneur, (b) implementing knowledge and ideas into practice, (c) dissatisfaction in professional occupation, (d) looking for alternative careers, (e) enhancing employability, (f) getting access to networks, and (g) improving knowledge and skillset in commercialisation.
Background Information	(Pfeifer *et al.*, 2016a; Webb, 2010)	Respondent's background information: (a) sex, (b) minority background, (c) parents' occupations, (d) marital status, and (e) major field of study.

5.4.4 Statistical Analysis

Coding and Exploratory Data Analysis

Before analysing the quantitative data collected, the raw data from the pre- and post-surveys was exported from Qualtrics™ into a spreadsheet (.xlxs) whose format is compatible with SPSS™ and STATA™, the statistical software used in this thesis for the quantitative analysis. The raw data was then coded based on the codebook attached in **Appendix C.** Most data types were numerically coded with some exceptions of categorical coding. Numerical coding facilitates further re-coding to create new variables for subsequent analyses (Berman Brown and Saunders, 2008). The variables that were categorically coded are prior entrepreneurial exposure and demographic information of the respondents. To ensure no data errors, the data coded was rechecked to avoid illegitimate codes and illogical relationships. Once the data was coded and checked for errors, the preliminary factor analysis, specifically Principal Component Analysis, was conducted as described in the next section.

Principal Component Analysis of Factors

A Principal Component Analysis (PCA) was conducted to establish the level of reliability of each perceived barrier and simplify the perceived barrier variables in the regression model. PCA is regarded as a preferable factor analysis technique widely employed in conjunction with Regression Analysis, particularly within the entrepreneurship literature (Lee *et al.*, 2011; Sá and Pinho, 2019; Sieger *et al.*, 2016). The perceived barrier factors were reiterated until there was no cross-loading between each group of perceived barriers with a value higher than 0.4 (Hair *et al.*, 1993). Some variables were removed and re-grouped to ensure acceptable factor loadings. Subsequently, descriptive statistics were conducted to describe and compare the variables numerically. The numerical variables were measured through means, standard deviation (s.d.), median, minima (Min.) and maxima (Max.) to present the average of all data values and to compare the differences of data values between all variables (Bacq and Alt, 2018).

Regression and Difference-in-Differences Analyses

Table 7 below summarises the data analysis strategy of the quantitative study to test each hypothesis. To test the hypothesised model, the study began by conducting paired-sample *t-tests* and Difference-in-Differences analyses to compare within-group and between-group difference of the EEC impact on perceived gender barriers to entrepreneurship, ESE and EI of men and women participants (H1, H2, H3, H4a, and H4b). Subsequently, the regression analysis was employed to test the mediating role of ESE between the relationships of perceived gender barriers to entrepreneurship and EI (H5). Finally, the Pearson Correlations and Difference-in-Differences analyses were also employed to compare the impact of the EEC programme on EI of men and women participants with different pre-disposition backgrounds (H6, H7a, H7b and H8).

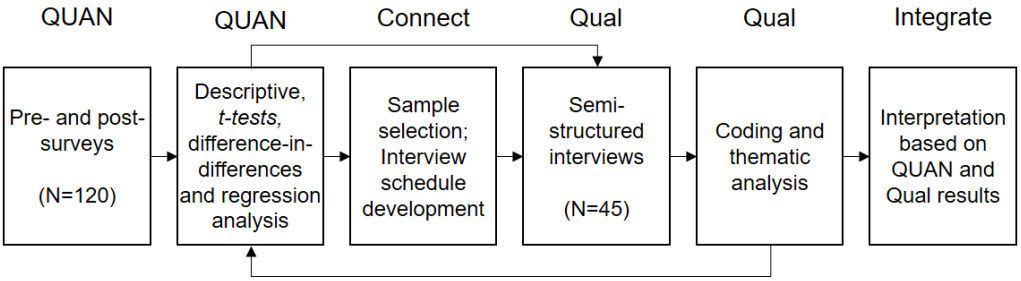
Table 7 *Data Analysis for Hypothesis Testing*

Hypothesis	Data Analysis
H1: Following EEC attendance, STEMM women ECRs demonstrate lower EI than their male counterparts	**Paired Sample t-test (within group)** **Difference-in-Differences Analysis (between group)** *Pre-Perceived Barriers (t1-t2) by Sex*
H2: Following EEC attendance, STEMM women ECRs demonstrate lower ESE than their male counterparts	**Paired Sample t-test (within group)** **Difference-in-Differences Analysis (between group)** *Change in Perceived Barriers (t1-t2) by Sex*
H3: Prior to EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts	
H4a: Following EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts	**Paired Sample t-test (within group)** **Difference-in-Differences Analysis (between group)** *Change in Perceived Self-Efficacy (t1-t2) by Sex*
H4b: Following EEC attendance, STEMM women ECRs perceive lower gender barriers to entrepreneurship than their male counterparts	**Paired Sample t-test (within group)** **Difference-in-Differences Analysis (between group)** *Change in Entrepreneurial Intentions (t1-t2) by Sex*

Hypothesis	Data Analysis
H5: ESE mediates the relationship between gender barriers to entrepreneurship and EI of STEMM women ECRs	**Regression - PROCESS (Pre- and Post-Data)** *Perceived Barriers → Self-Efficacy → Intentions*
H6: Following EEC attendance, participants with high Pre-EI demonstrate insignificant change in EI	**Pearson Correlations (within group)** **Difference-in-Differences Analysis (between group)** *Change in Entrepreneurial Intentions (t1-t2) by Sex* *Controlling for pre-education entrepreneurial intentions*
H7a: Prior entrepreneurial exposure positively influences Pre-EI of EEC participants	**Pearson Correlations (within group)** **Difference-in-Differences Analysis (between group)** *Change in Entrepreneurial Intentions (t1-t2) by Sex* Controlling for prior entrepreneurial exposure
H7b: Following EEC attendance, participants with prior entrepreneurial exposure demonstrate insignificant change in EI	**Pearson Correlations (within group)** **Difference-in-Differences Analysis (between group)** *Entrepreneurial Intentions (t1) by Sex* Controlling for prior entrepreneurial exposure
H8: The higher the level of entrepreneurial motivation, the higher the level of Pre-EI of EEC participants	**Pearson Correlations (within group)** **Difference-in-Differences Analysis (between group)** *Entrepreneurial Intentions (t1) by Sex* Controlling for entrepreneurial motivation for participation

The quantitative study provided partial answers to the research question, in regard to the EEC impact upon perceived gender barriers to entrepreneurship, ESE and EI of women participants in comparison to their male counterparts. Apart from the hypothesis testing, the quantitative study also suggested gender implications that had arisen from the quantitative findings which will be discussed further in **Section 6.7.4 (Chapter 6)**. The quantitative data was used to guide the interview sampling and interview schedule development of the qualitative study; aiming to explain "How" and "Why" the EEC programme influenced women participants in such ways. **Figure 7** provides the visualisation of how the quantitative and qualitative research process and findings integrated. The next section describes the qualitative research strategy employed in this study.

Figure 7 *Integration of QUAN → Qual Research Process and Results adapted from Ivankova (2014)*



5.5 Research Methods: Qualitative Study

This section discusses the qualitative research strategy whose analysis was conducted to establish heterogeneous experience of women participants and explore any emerging themes or patterns from the qualitative data set. The section begins by discussing the sampling strategy employed to ensure maximum variation, diverse patterns and experience of STEMM women ECRs to achieve the validity of the qualitative findings (Saunders *et al.*, 2016). Subsequently, the section reports the interview participation rate and details regarding the semi-structured interviews conducted in this thesis. Finally, the section outlines the Thematic Analysis procedure adopted to analyse the qualitative data set.

5.5.1 Interview Participation and Research Sampling

This thesis achieved a satisfactory interview participation rate. Given that the recommended minimum sample size for a heterogeneous population is between 12-30 target samples (Creswell and Plano Clark, 2018), the study aims to interview a minimum of 30 women participants to achieve the confirmability and validity of qualitative findings. Out of the total of 79 women participants, **45 women from 16 universities with 19 nationalities were interviewed** – exceeding the expected participation by 15 participants.

The ***purposive heterogeneous sampling*** technique was employed by selecting women participants who reported different scores on key factors from the

quantitative findings to examine different reasons behind different results (Creswell and Plano Clark, 2018). This technique allowed the researcher to capture the experience of women participants whose scores are on the average and at the end of each spectrum (e.g. those who reported high Pre-EI, average Pre-EI and low Pre-EI). The researcher could also cover all women participants across different predispositions (e.g. women who had prior entrepreneurial motivation and those who had not). As a result, the thesis is able to: (a) explain the tested hypotheses as well as (b) capture unique experience and variation that emerged from the women interviewees who had different perception, characteristics and conditions (Palinkas *et al.*, 2015). However, it is acknowledged that a small sample may contain completely different patterns and experiences which, in contrast, are argued to be a strength of this sampling technique (Patton, 2002). The patterns that emerged tend to be of particular interest and value, representing key themes and allowing the researcher to document its uniqueness (Patton, 2002).

The quantitative analysis (see Section 6.7.4 in Chapter 6) highlighted key gender implications that had arisen from the quantitative findings and suggested that the qualitative study should pay attention to specific aspects of EI, ESE and perceived barriers levels of women participants as well as their particular predisposition levels. Table 8 provides an example of how participants' diverse predisposition and EI levels were ensured to provide possible maximum variation of data collected.

Table 8 Heterogeneous Purposive Sampling

EI Levels and Predisposition	Low (%)	Average (%)	High (%)	Total Participants (%)
Entrepreneurial Motivation	21 (47%)	6 (13%)	18 (40%)	45 (100%)
Pre-EI	19 (42%)	6 (13%)	20 (45%)	45 (100%)
• 4 women (9%) have started a business • 11 women (27%) have worked in a start-up • 14 women (33%) have attended a taught module in business • 14 women (33%) have attended a workshop in business • 8 women (18%) have attended an online course • 6 women (13%) have attended an EEC programme				

5.5.2 Semi-Structured Interviews

This thesis employed semi-structured interviews to explore diverse experience of women participants (Creswell and Plano Clark, 2018). Most of the semi-structured interviews were conducted within seven days after each competition round. From a total of 45 interviewees, 37 women were interviewed face-to-face and eight women were interviewed via Skype™. The average length of each interview is 60 minutes. All interviewees completed both pre- and post-surveys which were then used during the interview to explore specific events (mechanisms) during the competition that influenced their particular perceived gender barriers to entrepreneurship, ESE and EI, as highlighted in the quantitative findings. The interviewees were asked similar questions based on the interview schedule attached in **Appendix D.** In addition, each interviewee was asked specific follow-up questions to explain their thoughts on significant factors that they reported to be particularly high, low or unchanged (Creswell and Plano Clark, 2018; Igo *et al.*, 2008). Their anonymity and confidentiality were preserved through the use of pseudonyms for interviewees' names and for the interview locations (Saunders *et al.*, 2016).

5.5.3 Qualitative Analysis

Thematic Analysis

This thesis employed Thematic Analysis as an appropriate method for the qualitative analysis. The thematic approach was employed to search for themes or patterns in the data set in relation to the research objectives and question (Braun and Clarke, 2006) and, ultimately, to establish heterogeneous experience of women participants (Creswell and Plano Clark, 2018). Thematic Analysis is a foundational method of qualitative analysis and is known as a systematic but flexible and accessible approach to analyse qualitative data (Braun and Clarke, 2006). The thematic analysis: (a) provides flexibility as it does not tie to a specific philosophical position, (b) is applicable for both inductive and deductive reasoning, and, therefore, (c) allows the researcher to analyse a data set of any size leading to rich descriptions and theorisation (Saunders *et al.*, 2016).

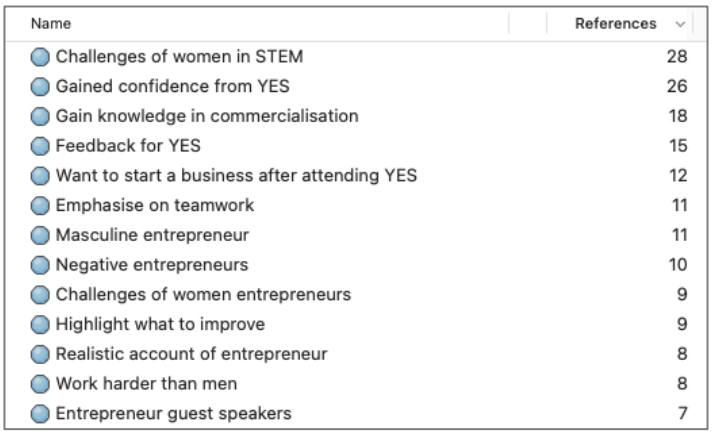
Supporting a critical realist approach, thematic analysis provides a 'latent approach' as it looks beyond a descriptive (semantic) level of analysis by seeking to identify theorised ideas, assumptions and conceptualisations (event and structures/mechanisms) underlying the phenomena (Braun and Clarke, 2006; Maxwell, 2012; Thorpe, 2019).

Transcribing and Coding the Data

The interviewed data was transcribed by the researcher to gain familiarity with the data collected. The word-processed transcripts were named by interview number to maintain confidentiality and saved in a password-protected folder on a University of Nottingham server. The thesis employed the following key steps in conducting thematic analysis recommended by Braun and Clarke (2006).

First, the transcripts were imported into NVivo™. The researcher read through all transcripts, familiarised themselves with the data and initially categorise data with similar meanings. The comments and notes were made as nodes of keywords. Each quote was linked to one or more of these nodes. **Figure 8** presents an example of initial nodes which represent keywords that the researcher assigned different quotes to. Each appropriate data unit from the transcripts was attached to these initial nodes.

Figure 8 *Categorising Interview Data Example*

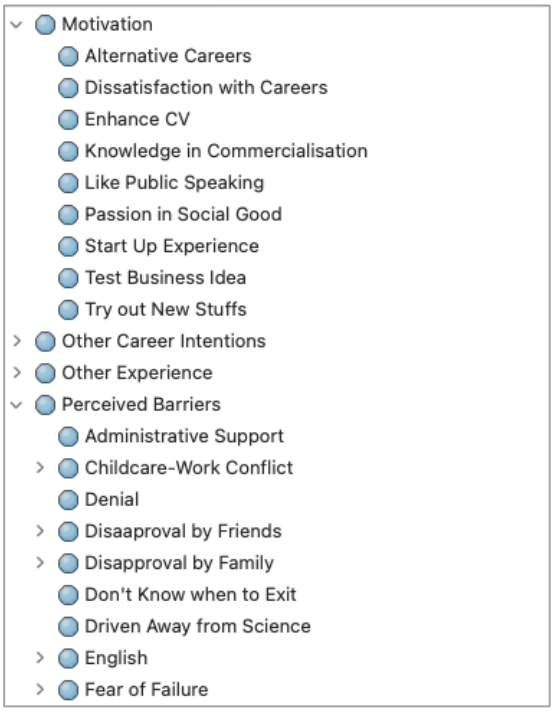


Name	References
Challenges of women in STEM	28
Gained confidence from YES	26
Gain knowledge in commercialisation	18
Feedback for YES	15
Want to start a business after attending YES	12
Emphasise on teamwork	11
Masculine entrepreneur	11
Negative entrepreneurs	10
Challenges of women entrepreneurs	9
Highlight what to improve	9
Realistic account of entrepreneur	8
Work harder than men	8
Entrepreneur guest speakers	7

Second, these nodes were collated into initial codes derived from the academic literature and the interview schedule **(See Appendix E)**. Any unit of data that was

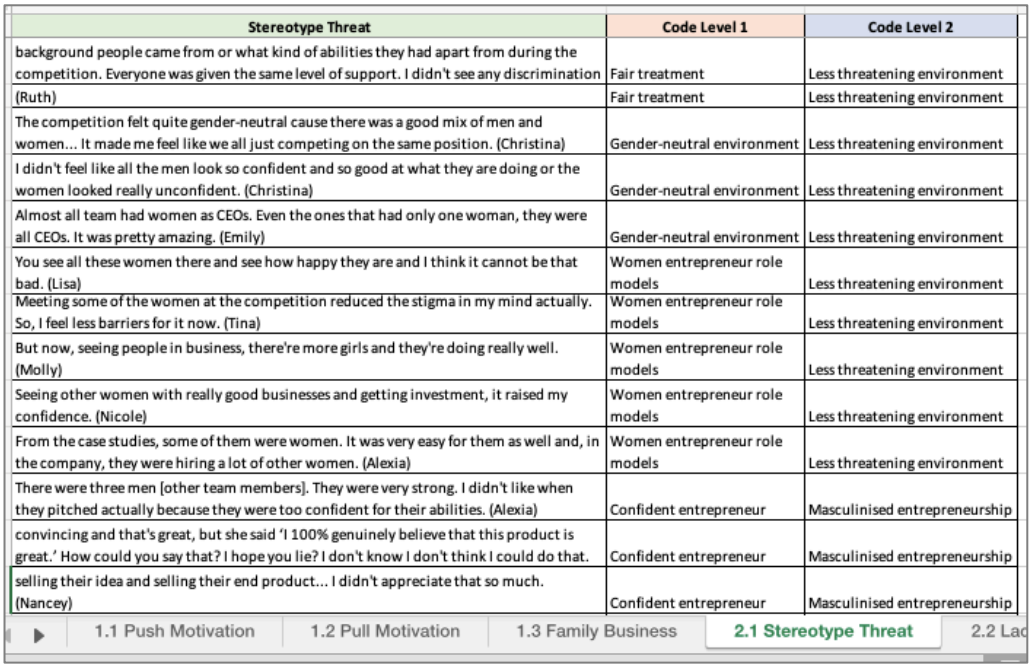
related to but did not fit into any of these coding categories was added as new coding categories or sub-categories. Any codes that contain relatively larger amounts of data were subdivided into further codes. During the coding stage, each transcript was created as a case with its own attributes. This is to create a segmentation of the interviewees which was used to explain the tested hypotheses and gender implications that arose from the quantitative study. Primarily, the attributes were derived from the research hypotheses and the respondent's background information collected from the pre-surveys. Each interview case was classified by the attributes outlined in Appendix F. Figure 9 presents an example of initial coding.

Figure 9 Initial Coding Example



Third, the initial coding was exported to Microsoft Excel™ and was collated into potential themes in relation to extracted code and entire dataset to generate a thematic map of the analysis. Figure 10 presents the final themes and sub-themes analysed using Microsoft Excel™.

Figure 10 *An Example of Analysing Final Themes and Sub-themes*



Stereotype Threat	Code Level 1	Code Level 2
background people came from or what kind of abilities they had apart from during the competition. Everyone was given the same level of support. I didn't see any discrimination	Fair treatment	Less threatening environment
(Ruth)	Fair treatment	Less threatening environment
The competition felt quite gender-neutral cause there was a good mix of men and women... It made me feel like we all just competing on the same position. (Christina)	Gender-neutral environment	Less threatening environment
I didn't feel like all the men look so confident and so good at what they are doing or the women looked really unconfident. (Christina)	Gender-neutral environment	Less threatening environment
Almost all team had women as CEOs. Even the ones that had only one woman, they were all CEOs. It was pretty amazing. (Emily)	Gender-neutral environment	Less threatening environment
You see all these women there and see how happy they are and I think it cannot be that bad. (Lisa)	Women entrepreneur role models	Less threatening environment
Meeting some of the women at the competition reduced the stigma in my mind actually. So, I feel less barriers for it now. (Tina)	Women entrepreneur role models	Less threatening environment
But now, seeing people in business, there're more girls and they're doing really well. (Molly)	Women entrepreneur role models	Less threatening environment
Seeing other women with really good businesses and getting investment, it raised my confidence. (Nicole)	Women entrepreneur role models	Less threatening environment
From the case studies, some of them were women. It was very easy for them as well and, in the company, they were hiring a lot of other women. (Alexia)	Women entrepreneur role models	Less threatening environment
There were three men [other team members]. They were very strong. I didn't like when they pitched actually because they were too confident for their abilities. (Alexia)	Confident entrepreneur	Masculinised entrepreneurship
convincing and that's great, but she said 'I 100% genuinely believe that this product is great.' How could you say that? I hope you lie? I don't know I don't think I could do that.	Confident entrepreneur	Masculinised entrepreneurship
selling their idea and selling their end product... I didn't appreciate that so much. (Nancey)	Confident entrepreneur	Masculinised entrepreneurship

Recognising Relationships and Emerging Themes

This thesis employed Explanatory Sequential Design (QUAN → Qual). As shown in Table 9, both quantitative and qualitative results inform the objectives of the research. The aim of the qualitative analysis is to elaborate and contextualise the experience of STEMM women ECRs before, during and after attending the EEC programme. At the end of this analysis stage, emerging themes and sub-themes were identified as additional results of the research.

Table 9 *Matching Research Hypotheses to Survey and Interview Questions*

Objective 1: To investigate the extent to which the EEC programme impacts perceived gender barriers to entrepreneurship, ESE and EI of STEMM women ECRs	Related Survey Questions	Related Interview Questions
H1: Following EEC attendance, STEMM women ECRs demonstrate lower EI than their male counterparts	Q2.1 – Q2.6 Q9	Q2.1 – Q2.10 Q7.1 – Q7.4
H2: Following EEC attendance, STEMM women ECRs demonstrate lower ESE than their male counterparts	Q3.1 – Q3.8 Q9	Q3.1 – Q3.6
H3: Prior to EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts	Q4.1 – Q6.9 Q9	Q4.1 – Q6.2
H4a: Following EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts		

H4b: Following EEC attendance, STEMM women ECRs perceive lower gender barriers to entrepreneurship than their male counterparts		
Objective 2: To investigate to what extent perceived gender barriers to entrepreneurship influence ESE and EI of STEMM women ECRs	**Related Survey Questions**	**Related Interview Questions**
H5: ESE mediates the relationship between gender barriers to entrepreneurship and EI of STEMM women ECRs	Q2.5 Q3.1 – Q3.8 Q4.1 – Q6.9 Q9	Q2.1 – Q2.10 Q3.1 – Q3.6 Q4.1 – Q6.2 Q7.1 – Q7.4
Objective 3: To investigate to what extent the potential impact of the EEC programme is influenced by individual predispositions	**Related Survey Questions**	**Related Interview Questions**
H6: Following EEC attendance, participants with high Pre-EI demonstrate insignificant change in EI	Q2.1 – Q2.6 Q3.1 – Q3.8 Q4.1 – Q6.9 Q9	Q1.1 – Q1.5 Q2.1 – Q2.10 Q4.1 – Q6.2 Q7.1 – Q7.4
H7a: Prior entrepreneurial exposure positively influences Pre-EI of EEC participants	Q2.1 – Q2.6 Q3.1 – Q3.8 Q4.1 – Q6.9 Q7.1 – Q7.7 Q9	Q2.1 – Q2.10 Q4.1 – Q6.2 Q7.1 – Q7.4
H7b: Following EEC attendance, participants with prior entrepreneurial exposure demonstrate insignificant change in EI	Q2.1 – Q2.6 Q7.1 – Q7.7 Q9	Q2.1 – Q2.10
H8: The higher the level of entrepreneurial motivation, the higher the level of Pre-EI of EEC participants	Q1.1 – Q1.8 Q9	Q1.1 – Q1.5 Q2.1 – Q2.10

5.5.4 Reflective Statement

Reflexivity is considered as an important aspect within feminist scholarship and reflexive empirical research. Given the role of self in generating knowledge (Haraway, 1988), the process of construction of knowledge does not only requires something to construct (research participants), but also a constructing subject (the researcher) and a social context that constructs the researcher (Alvesson and Sköldberg, 2017). Reflexivity is defined as "*self-critical sympathetic introspection and the self-conscious analytical scrutiny of the self as researcher*" (England, 1994, p. 82). Upon my reflection, my identities as an early-career, female, international (Thai), postgraduate researchers and a recent

mother of a young child influenced the dynamics of power and authority, between myself and my research participants, which affected my approaches to data collection and interpretation.

My profile as a female international postgraduate researcher facilitated my data collection as over a half of my interviewees are international PhD students and postdoctoral researchers. Even though most of them are not from Asia, they could relate to my background and treated me as one of their colleagues. For instance, they invited me for dinner following the interviews. The shared gender identity and academic role identity facilitated the bond I was able to build with STEMM women ECRs. Throughout the study, there were mutual instances based on different occasions including: (a) our early academic-career stage, (b) our experience facing sex discrimination in workplace, (c) our experience as international students studying in the UK and (d) our perceived conflict in future childcare and work plans. This enabled them to speak more openly about their personal issues and relationships making the positions of power and authority in these categories of difference were more easily negotiated.

However, I sometimes felt a degree of outsider during the interviews due to my background in social science. My limited experience and knowledge in regard to STEMM subjects serve as a challenge relating to their PhD research, business ideas they developed during the competition or their future business ideas. I always ensured that they acknowledged my differential background and that I captured sufficient insights to address my research questions which do not need detailed explanations and complex scientific terms.

After the data collection, I gained an additional identity as a mother during my PhD study. I went on a maternity leave before I resumed my PhD study at my data analysis stage. Having gained an experience of a PhD mother after the data collection phase, I had to be mindful to challenge my preconceptions based on my interviewees' responses in relation to my own experiences. The critical realist analysis facilitated my approach to mitigating this risk as it allows me to

search for multiple alternative explanations for the phenomenon which I could test using various sources of evidence.

5.6 Ethical Considerations

The thesis obtained ethical approval for both traditional and internet-mediated accesses. The traditional access involves face-to-face semi-structured interviews and individual following-up with the EEC participants to complete the pre-surveys on the first day of the competition. The internet-mediated access involves the distribution of pre- and post-surveys as well as the online semi-structured interviews conducted via Skype™. Initially, the researcher has gained physical entry approval from the EEC's programme director and manager. In addition, the research project received a favourable ethical opinion from the University of Nottingham Business School Research Ethics Committee. The research was carried out in accordance with the University of Nottingham Code of Research Conduct and Research Ethics (2016) and the ethical guidelines provided by the British Educational Research Association (2018). The Participants Information Sheet (see **Appendix G**) was shared with all respondents and interview participants, and their consent was gained prior to completing the pre- and post-surveys and prior to their participation in the semi-structured interviews.

5.7 Summary

This chapter sets out the ontological and epistemological perspectives underpinning this thesis, and the use of a mixed-methods approach, in order to address the overarching research question: "To what extent does the EEC, as a vehicle of EE, influence perceived gender barriers to entrepreneurship, ESE and in turn EI of STEMM women ECRs?" Relying on the critical realist philosophy, the thesis is not restricted by the quantitative versus the qualitative debate. Instead, it aims to provide suggestive/indicative but fallible outcomes based on the results from this study instead of suggesting a generalised and universal answer. It employs Explanatory Sequential Design (QUAN → Qual) to compensate for the weaknesses of each research approach as well as to enhance reflexivity,

relevance and validity of positivist-dominated research (Elkjaer and Simpson, 2011; Watson, 2013). While the quantitative data captured the measurable impact of the EEC programme, the qualitative data explored heterogeneous experience of women participants as well as explored any emerging themes and patterns (Patton, 2002; Saunders *et al.*, 2016). The next chapter will present the quantitative findings of this thesis.

6. Quantitative Results

The previous chapter justified the philosophical assumptions underlying this thesis and outlined the mixed-methods research strategy (QUAN → Qual) employed to address the research question: "*To what extent does the enterprise education competition (EEC), as a vehicle of entrepreneurial education (EE), influence perceived gender barriers to entrepreneurship, entrepreneurial self-efficacy (ESE) and in turn entrepreneurial intentions (EI) of STEMM women early career researchers (ECRs)*?" This chapter presents the analyses of the quantitative data which will subsequently inform the scope of the qualitative analysis. The chapter begins by presenting the characteristics of the respondents in relation to their predisposition levels – their motivation to participate in the EEC programme, prior entrepreneurial exposure and pre-competition entrepreneurial intentions (Pre-EI). The subsequent section discusses the factor analysis of perceived barriers' subscales and reliability analysis of the dependent and independent variables. The section then presents the results of hypothesis testing and discusses gender implications that arose from the quantitative findings. Finally, the chapter summarises the overall results and directions for the qualitative data analysis.

6.1 The Characteristics of the Respondents

This section provides the demographical overview of the respondents. The pre- and post-surveys achieved a complete response rate of 87% (N = 120). As presented in Table 10, women accounted for the majority of the respondents (57.5%). Most respondents were British (55.8%). Respectively, respondents were in the field of biosciences (41.7%), life science (23.3%) engineering (20%), chemistry (4.2%), physics and math (2.5%) and others (8.3%) – such as medicine, dentistry, pharmacy, veterinary, material science and geology. Most participants were single (49.2%), with the remainder partnered (35.8%), married (13.3%) and divorced (1.7%).

Table 10 *The Characteristics of the Respondents*

Characteristics	No. of Respondents	% Respondents*
Sex		
Female	69	57.5%
Male	51	42.5%
Nationality		
British	67	55.8%
Non-British	53	44.2%
Ethnicity Minority Background		
White	87	72.5%
Non-White	33	27.5%
Academic Discipline		
Biosciences	50	41.7%
Life Sciences	28	23.3%
Engineering	24	20.0%
Chemistry	5	4.2%
Physics and Math	3	2.5%
Others	10	8.3%
Marital Status		
Single	59	49.2%
Partnered	43	35.8%
Married	16	13.3%
Divorced	2	1.7%
*as a percentage of the total number of respondents		

6.2 Descriptive Statistics

This section provides descriptive statistics and correlations of the dependent, independent and control variables of the study. The descriptive statistics and Pearson correlations of the variables are presented in Table 11 and Table 12.

Table 11 *Descriptive Statistics and Pearson Correlations of Variables*

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
Dependent Variable													
1. Change: EI	1												
Independent Variables													
2. Change: ESE	0.021	1											
3. Change: Stereotype	-0.152	**-.369****	1										
4. Change: Discrimination	-0.023	-0.131	**.433****	1									
5. Change: Family Disapproval	-0.064	-0.082	0.152	**.292****	1								

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
6. Change: Friend Disapproval	0.112	-0.041	0.074	.180*	0.131	1							
7. Change: Role Model	-0.104	-0.106	.236**	.380**	0.126	-0.031	1						
8. Change: Networking	-0.046	-0.134	0.037	-0.045	-.222*	-0.139	.435**	1					
9. Change: Admin Support	-0.136	-.525**	.263**	0.004	-0.012	0.009	-0.079	0.078	1				
10. Change: Obtain Finance	-0.067	-.253**	0.145	0.117	-0.119	0.051	0.127	0.170	0.128	1			
11. Change: Stakeholders	-0.052	-.327**	0.116	0.151	0.171	0.162	0.106	0.119	.244**	.377**	1		
12. Change: Childcare-Work	-0.111	-0.074	-0.120	-0.178	.208*	-0.013	-0.085	.263**	0.043	0.036	0.147	1	
13. Change: Lack Confidence	-0.012	-0.177	.262**	.247**	0.175	0.142	.400**	.344**	0.042	0.097	0.075	0.061	1
Control Variables													
14. Pre-EI	.533**	0.009	0.034	0.094	0.116	.252**	0.139	0.002	-0.085	-0.142	-0.127	-0.001	.383**
15. High Pre-EI	.418**	-0.031	-0.010	0.124	0.149	.216*	0.169	-0.005	-0.069	-0.168	0.013	0.024	.278**
16. High Motivation	.282**	0.034	0.038	.238**	0.142	0.106	.270**	-0.016	-0.155	-0.046	0.002	-0.123	.324**
17. Family Business	-0.139	-0.004	0.022	0.021	0.175	0.021	0.044	0.052	0.057	-0.057	0.054	-0.085	0.121
18. Started a Business	0.009	0.086	-0.003	-0.053	-0.008	0.158	0.034	-0.092	-0.098	-0.046	-0.179	-0.035	0.164
19. Worked in a Start-up	0.130	0.067	-0.012	0.024	0.043	0.095	0.105	0.001	-0.138	-0.058	-0.022	-0.031	0.096
20. Taught Module	0.063	0.175	-0.053	0.079	0.019	0.069	0.151	-0.052	-.234*	-0.031	-0.054	-0.056	0.075
21. Workshop	0.081	.237**	-0.121	-0.051	0.055	0.090	0.047	0.034	-0.175	0.005	-0.007	0.046	0.008
22. Online Course	0.031	0.078	-0.028	0.084	.204*	0.171	0.027	-0.057	-0.109	-0.010	0.094	0.050	0.064
23. EEC Programme	0.129	-0.017	-0.088	-0.164	0.048	0.059	0.020	-0.028	-0.039	-0.135	-0.057	0.012	0.069
24. Female	-0.024	-0.074	.312**	-0.089	-0.129	-0.038	-0.083	0.053	0.132	0.031	0.074	-.189*	0.005
25. Minority Background	0.137	0.090	-0.029	-.208*	-0.024	0.007	-0.017	0.163	-0.012	-0.013	-0.068	-0.005	0.110
26. Married Status	-0.060	-0.078	-0.150	-0.035	-0.040	-0.084	-0.031	0.047	0.013	0.010	0.020	-0.027	-0.040
Mean	-0.28	-0.95	0.47	0.52	0.98	1.11	-0.44	-1.24	1.02	-1.03	-0.03	0.34	-0.16
S.D.	1.01	0.83	0.96	0.95	0.86	1.09	1.53	1.49	1.07	1.26	1.02	0.80	0.92

Table 12 *Descriptive Statistics and Pearson Correlations of Variables (Continued)*

Variables	14	15	16	17	18	19	20	21	22	23	24	25	26
Control Variables													
14. Pre-EI	1												
15. High Pre-EI	.832**	1											
16. High Motivation	.677**	.688**	1										
17. Family Business	0.044	0.076	0.076	1									
18. Started a Business	.245**	.259**	.259**	0.171	1								

Variables	14	15	16	17	18	19	20	21	22	23	24	25	26
19. Worked in a Start-up	.265**	.251**	.251**	0.173	.317**	1							
20. Taught Module	0.121	0.175	0.175	-0.022	0.005	.201*	1						
21. Workshop	.237**	.201*	.273**	0.044	0.019	.223*	.332**	1					
22. Online Course	.203*	0.154	0.154	0.076	-0.101	0.025	.258**	.312**	1				
23. EEC Programme	.188*	.180*	.180*	0.049	0.111	.243**	.280**	.231*	0.020	1			
24. Female	-0.030	-0.021	0.048	0.139	-0.041	0.130	0.052	-0.020	0.019	0.050	1		
25. Minority Background	.192*	0.145	0.107	0.064	0.135	0.109	0.088	0.068	-0.120	.183*	0.114	1	
26. Married Status	-0.026	0.030	0.080	0.102	.190*	0.077	-0.107	-0.127	0.148	0.087	0.040	.198*	1
Mean	3.02	0.40	0.40	0.43	0.07	0.18	0.24	0.34	0.13	0.12	0.58	0.28	0.13
S.D.	1.22	0.49	0.49	0.50	0.25	0.38	0.43	0.48	0.33	0.32	0.50	0.45	0.34

6.3 Predispositions of the Respondents

This section provides the comparison of predispositions between men and women participants prior to EEC attendance. These predispositions include: (1) motivation to participate in the EEC programme, (2) prior entrepreneurial exposure, and (3) pre-competition entrepreneurial intentions (Pre-EI).

6.3.1 Motivation to Participate into the EEC Programme

The top three reasons women participants reported for participating in the EEC programme were to: (1) enhance their employability (Mean = 4.62), (2) improve their knowledge and skills in commercialisation (Mean = 4.52) and (3) identify potential alternative careers (Mean = 4.46). Women participants exhibited significantly higher motivation to explore potential alternative careers when compared to their male counterparts.

Table 13 Motivation to Participate in the EEC Programme by Sex

Motivation to Participate in the EEC Programme	Women (Mean)	Men (Mean)	Mean Difference	Sig. (2-tailed)
To enhance my employability	4.62	4.51	0.11	.361
To improve my knowledge and skillset in commercialisation	4.52	4.39	0.13	.340
To identify potential alternative careers	4.46	4.12	0.34	**.031***

Motivation to Participate in the EEC Programme	Women (Mean)	Men (Mean)	Mean Difference	Sig. (2-tailed)
To get access to networks of mentors and entrepreneurs	4.20	4.00	0.20	.204
To implement knowledge and ideas into practice	3.99	3.88	0.11	.596
Encouragement from colleagues	3.3	2.96	0.34	.113
To become a business owner	3.00	2.96	0.04	.867
Dissatisfaction in my professional occupation	2.17	2.33	-0.16	.453

*p < 0.05; **p < 0.01; ***p < 0.001; Two-tailed Test.

6.3.2 Prior Entrepreneurial Exposure

Overall, it is noticeable that there are more women participants who had prior entrepreneurial exposure when compared to their male counterparts. The number of women participants who have a family business background (34 women to 18 men) and have worked in a start-up (15 women to 6 men) is twice as high as the proportion of men participants. However, based on the Chi-Square test, no significant difference was found between numbers of women and men participants with and without prior entrepreneurial exposure.

Table 14 *Prior Entrepreneurial Exposure by Sex*

Prior Entrepreneurial Exposure	Women (N = 69)	Men (N = 51)	Diff.	*p*
Family has owned a business	34	18	16	.127
Have attended a workshop in business	23	18	5	.823
Have attended a taught module in business	18	11	7	.568
Have worked in a start-up	15	6	9	.155
Have attended an online course in business	9	6	3	.834
Have attended a business plan competition	9	5	4	.585
Have started a business	4	4	0	.657

*p < 0.05; **p < 0.01; ***p < 0.001; Two-tailed Test.

6.3.3 Pre-Competition Career Intentions

Prior to EEC attendance, participants were asked to identify their preferred career pathways. Their three most preferable careers were industrial research, industrial management, and academic research. Entrepreneurship was ranked as the fourth desirable career choice among the respondents (Mean = 2.99). There was no significant difference in career intentions between men and women participants prior to EEC attendance.

Table 15 *Pre-Competition Careers Intentions by Sex*

Pre-Competition Career Intentions	Women (Mean)	Men (Mean)	Mean Diff.	*p*
Industrial research	4.12	3.84	0.27	.100
Academic research	3.38	3.37	0.01	.985
Industrial management	3.54	3.29	0.24	.253
University management	2.68	2.51	0.17	.438
Entrepreneur	2.99	3.06	-0.07	.746
Government	2.84	2.98	-0.14	.489

*p < 0.05; **p < 0.01; ***p < 0.001; Two-tailed Test.

6.4 Principal Component Factor Analysis

This section presents the factor analysis of the perceived-barriers variables undertaken to condense the original sets of subscales of key perceived-barriers variables into smaller sets of subscales that can explain the original key variables with a minimal loss of information (Hair *et al.*, 2014). The data indicated the KMO value of .796 and a significant Bartlett's test ($\chi 2 = 2152.6$, df = 435, pb. 000). This indicates that the factor analysis was appropriate (Bartlett, 1950; Hair *et al.*, 2014; Kaiser, 1970). Subsequently, a Principal Component Factor Analysis (PCFA) with varimax rotation was employed. The initial investigation of the scree plot, percentage of variance accounted for and eigenvalues indicated that a seven-factor solution provided the most parsimonious factor solution for the perceived barriers subscales. These key perceived barriers were titled "Stereotype Threat," "Sex Discrimination," "Disapproval by Family," "Administrative Support," "Identifying Stakeholders," "Childcare and Work Conflict," and "Lack of Entrepreneurial Confidence." Apart from these seven factors, there are four key

perceived barriers which did not fit to the factor loadings but were retained as they are identified as theoretically significant within the literature review. These four key perceived barriers were titled "Disapproval by Friends," "Lack of Role Models and Mentors," "Networking Difficulty," and "Difficulty in Obtaining Finance". These four perceived barriers are single-item measures. Out of a total of 46 perceived barriers items, the following 11 items were removed due to their insignificant loadings (less than 0.4) and their loadings on multiple items: 7, 12, 15, 19, 20, 27, 30 , 40, 41, 43, and 46 (Hair *et al.*, 2014; Hinkin, 1995). Table 16 summarises 11 key perceived gender barriers to entrepreneurship with their related subscales and deleted items. More details on factor loadings of PCFA are attached in Appendix H.

Table 16 Key Perceived Barriers, Their Subscales and Deleted Items

Key Perceived Gender Barriers to Entrepreneurship
1. Stereotype Threat - Customers/suppliers lack faith in me as a business owner - Investors lack faith in me as a business owner - The people I know do not think I will be successful as a business owner
2. Sex Discrimination - Experiencing sexual harassment as a business owner - Experiencing sex discrimination as a business owner - Discrimination due to my marital status
3. Disapproval by Family - My parents/family don't approve of my choice to become a business owner - My spouse/partner doesn't approve of my choice to become a business owner - Not receiving support from my spouse/partner
4. Disapproval by Friends - My friends don't approve of my choice to become a business owner
5. Lack of Role Models and Mentors - Not having a role model or mentor in my business network
6. Networking Difficulty - Not knowing the "right people" to get my business ahead
7. Lack of Administrative Support - Support regarding start-up paperwork and bureaucracy - Organisations to assist business owners - Assistance in assessing business viability - Support regarding fiscal charges (tax, legal fees, etc.) - Legal assistance or counselling
8. Difficulty in Obtaining Finance
- Difficulties in obtaining finance

Key Perceived Gender Barriers to Entrepreneurship
9. Difficulty in Identifying Stakeholders - Difficulties in identifying customers - Difficulties in identifying suppliers - Difficulties in finding co-founders
10. Childcare and Work Conflict - Difficulty in maintaining the ground gained as a business owner after having children - Difficulty in continuing my business after taking time off to care for my children - Feeling guilty about working while my children are young - Needing to take time off work when children are sick or on school breaks - Having children at a "bad time" in the development of my business - Having an inflexible work schedule that interferes with my family responsibilities - Not being able to find good day-care services for my children - Feeling a conflict between my job and my family - Conflict between marriage/family plans and my career plans
11. Lack of Entrepreneurial Confidence - Business success is easier for other people - Fear that people will consider my character unsuitable for being a business owner - Believing that being a business owner is not appropriate for me - Fear of failure would prevent me from starting a business
Deleted Items #7: Difficulties in finding employees #12: Discrimination by customers/suppliers/investors because I have, or plan to have, children #15: Allowing my spouse/partner's desire for children to take precedence over my career goals #19: Not making as much money as a business owner #20: Other people believe that starting a business is not appropriate for me #27: Discrimination due to my marital status #30: Other business owners have better opportunities/deals/investments #40: Investors lack faith in me as a business owner #41: The people I know do not think I will be successful as a business owner #43: I often feel that people look down on me in business settings #46: I have the ability to run a successful business

6.5 Reliability Analysis

The results from the reliability analysis supported the high reliability of all scales employed in the post-survey (t2) results (Cronbach's $\alpha > 0.7$) (Hair *et al.*, 2014). The Cronbach's α values of the pre-survey (t1) results indicated moderate to high reliability (Cronbach's $\alpha > 0.4$). Table 17 summarises the overall reliability of each key construct. However, the following constructs are single-item

measures and therefore were not subject to reliability analysis: entrepreneurial intentions, disapproval by friends, lack of role models and mentors, networking difficulty, and difficulty in obtaining finance.

Table 17 *Reliability Analysis*

Key Constructs	No. of Items*	Cronbach Alpha	
		Pre-Survey (t1)	Post-Survey (t2)
Entrepreneurial Intentions	1	-	-
Entrepreneurial Self-Efficacy	8	.860	.786
Perceived Barriers			
- Stereotype Threat	3	.553	.788
- Sex Discrimination	3	.610	.813
- Disapproval by Family	3	.460	.822
- Disapproval by Friends	1	-	-
- Role Models and Mentors	1	-	-
- Networking Difficulty	1	-	-
- Administrative Support	5	.917	.869
- Difficulty in Obtaining Finance	1	-	-
- Identifying Stakeholders	3	.748	.712
- Childcare and Work Conflict	9	.630	.932
- Lack of Confidence	4	.543	.749
*Key construct with 1-item measure cannot be conducted the Cronbach Alpha			

6.6 Hypothesis Testing

This section provides statistical analyses to test the hypotheses of the study. Three stages of analyses were conducted. First, independent, paired sample *t-test*s and Difference-in-Differences analyses were conducted to compare the EEC impact upon EI, ESE and perceived gender barriers to entrepreneurship among and between women and men participants. Second, a four-step regression analysis of pre- and post-surveys (t1 and t2) was conducted to test the mediating role of ESE on the relationship between perceived gender barriers to entrepreneurship and EI of women and men participants. Lastly, independent sample *t-test*s and Difference-in-Differences analyses were employed to analyse to what extent participants' change in EI was influenced by their predisposition levels including their Pre-EI, entrepreneurial motivation and prior entrepreneurial exposure.

6.6.1 The EEC Impact on Entrepreneurial Intentions

This section aims to test **Hypothesis 1**: "Following EEC attendance, STEMM women ECRs demonstrate lower EI than their male counterparts" through independent, paired sample *t-tests* and difference-in-differences analyses. According to **Table 15 (Page 88)**, entrepreneurship was the fourth desirable career choice among the respondents before and after attending the programme. The top three desirable career choices among the participants were in industrial research, academic research and industrial management. Although entrepreneurship was not the most popular career choice, women participants demonstrated significantly higher EI after attending the EEC programme (mean diff. = 0.30, $p < 0.01$) while their intentions to pursue other career choices remained unchanged. Men participants did not demonstrate significant change in their career intentions. However, the Difference-in-Differences estimate indicates that this impact difference was not significant between both sexes; meaning no significant difference was found between EI of men and women participants before and after EEC attendance. Therefore, **Hypothesis 1 is not supported**.

Table 18 *The EEC Impact on Career Intentions by Sex*

Career Intentions	Women (M)			Men (M)			t1 Diff. by Sex	t2 Diff. by Sex	Impact Diff. by Sex[+]
	t1	t2	Diff.	t1	t2	Diff.			
Industrial research	4.12	4.07	-0.04	3.84	3.80	-0.04	-0.27	-0.27	0.00 (.145)
Academic research	3.38	3.35	-0.03	3.37	3.47	0.10	0.00	0.12	0.13 (.128)
Industrial management	3.54	3.57	0.03	3.29	3.31	0.02	-0.24	-0.25	-0.01 (.150)
University management	2.68	2.64	-0.04	2.51	2.49	-0.02	-0.17	-0.15	0.02 (.160)
Entrepreneur	2.99	3.29	**0.30****	3.06	3.31	0.25	0.07	0.02	-0.05 (.191)
Government	2.84	2.93	0.09	2.98	3.12	0.14	0.14	0.19	0.05 (.143)

t1 refers to pre-survey; t2 refers to post-survey

[+]Obtained by Difference-in-Differences Analysis with Robust Standard Errors in Parentheses.

*p < 0.05., **p < 0.01. ,***p < 0.001

6.6.2 The EEC Impact on Entrepreneurial Self-Efficacy

This section aims to test **Hypothesis 2**: "Following EEC attendance, STEMM women ECRs demonstrate lower ESE than their male counterparts." **Table 19** summarises the EEC impact upon ESE of women and men participants derived from independent, paired sample *t-tests* and Difference-in-Differences analyses. Prior to EEC attendance, women participants were most confident in business idea evaluation (M = 3.16), persuasion (M = 3.06) and R&D recruitment (M = 2.96) skills respectively. They were least confident in finance (M = 2.09), cost estimation (M = 2.26) and management recruitment (M = 2.62) skills. Among these skills, men participants were significantly more confident in finance (M = 2.51) and cost estimation (M = 2.69). Following EEC attendance, women and men participants demonstrated significantly higher confidence in their ESE. There is also no significant difference between the mean values of ESE (t2) and the EEC impact upon ESE of women and men participants. Therefore, **Hypothesis 2 is not supported.**

Table 19 *The EEC Impact on Entrepreneurial Self-Efficacy by Sex*

Entrepreneurial Self-Efficacy	Women (M)			Men (M)			t1 Diff. by Sex	t2 Diff. by Sex	Impact Diff. by Sex[+]
	t1	t2	Diff.	t1	t2	Diff.			
Finance	2.09	3.54	**1.45*** **	2.51	3.75	**1.24*** **	**-0.42***	-0.21	0.21 (.218)
Marketing	2.78	3.90	**1.12*** **	2.69	3.9	**1.22*** **	0.09	0.00	-0.10 (.197)
Supplier Management	2.71	3.45	**0.74*** **	2.49	3.25	**0.76*** **	0.22	0.20	-0.03 (.189)
Cost Estimation	2.26	3.62	**1.36*** **	2.69	3.61	**0.92*** **	**-0.43***	0.01	0.44 (.235)
Business Idea Evaluation	3.16	4.04	**0.88*** **	3.51	4.04	**0.53****	-0.35	0.00	0.35 (.236)
Management Recruitment	2.62	3.57	**0.94*** **	2.61	3.63	**1.02*** **	0.01	-0.06	-0.08 (.230)
R&D Recruitment	2.96	3.84	**0.88*** **	3.08	3.75	**0.67****	-0.12	0.09	0.22 (.251)
Persuasion	3.06	3.72	**0.67*** **	3.18	3.88	**0.71*** **	-0.12	-0.16	-0.04 (.208)
Total ESE	2.70	3.71	**1.01*** **	2.84	3.73	**0.88*** **	-0.14	-0.02	-0.12 (.152)

t1 refers to pre-survey; t2 refers to post-survey

[+]Obtained by Difference-in-Differences Analysis with Robust Standard Errors in Parentheses.

*p < 0.05., **p < 0.01. ,***p < 0.001

6.6.3 The EEC Impact on Perceived Gender Barriers to Entrepreneurship

This section aims to test **Hypothesis 3**: "Prior to EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts," **Hypothesis 4a**: "Following EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts," and **Hypothesis 4b**: "Following EEC attendance, STEMM women ECRs perceive lower gender barriers to entrepreneurship than their male counterparts." **Table 20** summarises the EEC impact upon perceived gender barriers to entrepreneurship of women and men participants, derived from independent, paired sample *t-tests* and Difference-in-Differences analyses. Prior to EEC attendance, women participants perceived significantly higher barriers to than those of men participants, in sex discrimination (M = 3.12), stereotype threat (M = 2.95), networking difficulty (M= 0.51) and childcare-work conflict (M = 0.21) respectively. Therefore, **Hypothesis 3 is supported**. Following EEC attendance, women participants perceived significantly lower barriers in administrative support (Diff. = -1.14), networking difficulty (Diff. = -1.07), disapproval by family (Diff. = -0.89), stereotype threat (Diff. = -0.46), and sex discrimination (Diff. = -0.45) respectively. Overall, women participants still perceived significantly higher barriers in sex discrimination (Diff. = 1.01) and childcare-work conflict (Diff. = 0.52). Therefore, **Hypothesis 4a is supported** and **Hypothesis 4b is not supported**.

Table 20 *The EEC Impact on Perceived Gender Barriers by Sex*

Perceived Gender Barriers	Women (M)			Men (M)			t1 Diff. by Sex	t2 Diff. by Sex	Impact Diff. by Sex[+]
	t1	t2	Diff.	t1	t2	Diff.			
Stereotype Threat	2.95	2.50	**-0.46*** **	2.41	2.56	0.15	**0.54*** **	-0.06	**0.60 (.172)** **
Sex Discrimination	3.12	2.67	**-0.45*** **	2.28	1.66	**-0.62*** **	**0.84*** **	**1.01*** **	-0.17 (.174)
Disapproval by Family	2.74	1.86	**-0.89*** **	2.92	1.81	**-1.11*** **	-0.18	0.04	-0.22 (.161)
Disapproval by Friends	2.87	1.80	**-1.07*** **	2.92	1.76	**-1.16*** **	-0.05	0.03	-0.84 (.200)
Role Models and Mentors	2.61	3.16	**0.55** **	2.49	2.78	0.29	0.12	0.38	-0.25 (.283)

Perceived Gender Barriers	Women (M)			Men (M)			t1 Diff. by Sex	t2 Diff. by Sex	Impact Diff. by Sex[+]
	t1	t2	Diff.	t1	t2	Diff.			
Networking Difficulty	2.17	3.35	**1.17*** **	1.67	3.00	**1.33*** **	**0.51****	0.35	0.16 (.272)
Administrative Support	3.67	2.53	**-1.14*** **	3.49	2.64	**-0.85*** **	0.18	-0.11	0.29 (.197)
Obtaining Finance	2.71	3.71	**1.00*** **	2.82	3.90	**1.08*** **	-0.11	-0.19	0.08 (.231)
Identifying Stakeholders	2.71	2.68	-0.03	2.63	2.75	0.12	0.09	-0.06	0.15 (.183)
Childcare-Work Conflict	3.10	2.89	**-0.21***	2.88	2.37	**-0.51*** **	**0.21***	**0.52****	**-0.30 (.144)***
Lack of Confidence	2.68	2.67	-0.01	2.53	2.55	0.02	0.15	0.12	0.01 (.172)

t1 refers to pre-survey; t2 refers to post-survey

[+]Obtained by Difference in Differences Analysis with Robust Standard Errors in Parentheses.

*p < 0.05., **p < 0.01. ,***p < 0.001

6.6.4 Perceived Gender Barriers to Entrepreneurship → ESE → EI

This section aims to test **Hypothesis 5**: "ESE mediates the relationship between gender barriers to entrepreneurship and EI of STEMM women ECRs." This thesis followed the guidelines of Baron and Kenny (1986) cited in Lee *et al.*, (2011) in testing the mediation effect. If the following four conditions are true, the mediation effect is supported: (1) the independent variables (perceived barriers) must significantly influence the mediator (ESE), (2) the independent variables (perceived barriers) must significantly influence the dependent variables (EI), (3) the mediator (ESE) must significantly influence the dependent variable (EI), and (4) if the full regression of the independent variables (perceived barriers) and the mediator (ESE) is run on the dependent variable (EI), the independent variables (perceived barriers) must not significantly influence EI. The regression results of women respondents are shown in **Table 21**. Model 1, 2, 3 and 4 present the regression results of the survey data collected prior to the EEC programme (t1). Model 5, 6, 7 and 8 are the regression results of the data collected following the EEC programme (t2). Model 3 and 7 show that ESE does not significantly influence EI at both t1 and t2. Therefore, **Hypothesis 5 is not supported**.

Table 21 *Regression Results of Women Respondents* (N= 69)

Independent/Dependent Variables	ESE (t1)	EI (t1)			ESE (t2)	EI (t2)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	4.435***	3.189***	3.126**	2.036***	4.479***	3.877***	1.940	1.879*
Controls								
Minority Background	0.142	0.087	0.085	0.064	-0.045	-0.108	-0.099	-0.088
Married Status	-0.026	-0.252**	-0.252*	-0.201**	0.216	-0.077	-0.120	-0.140
High Motivation	-0.091	0.140	0.140	0.246**	0.015	0.383	0.380*	0.433**
High Pre-EI	-0.064	0.719***	0.720***	0.668***	0.042	0.288	0.280	0.311
Family Business	0.003	-0.074	-0.074	-0.082	0.040	0.057	0.049	0.050
Started a Business	0.016	0.016	0.016	0.025	0.013	-0.091	-0.094	0.020
Worked in a Start-up	0.028	0.098	0.098	0.056	0.026	0.147	0.142	0.103
Taught Modules	0.073	-0.121	-0.122	-0.088	0.156	-0.225	-0.256	-0.191
Workshops	0.187	-0.046	-0.048	-0.047	0.012	0.013	0.011	-0.064
Online Courses	0.005	0.080	0.080	0.073	-0.154	0.065	0.096	0.146
Business Plan Competition	0.020	0.224*	0.224*	0.129	0.138	0.152	0.124	0.138
Main Effects								
Stereotype Threat	-0.318	-0.032	-0.029		-0.370*	0.002	0.075	
Sex Discrimination	0.157	0.139	0.137		0.151	-0.079	-0.109	
Disapproval by Family	-0.068	-0.046	-0.045		0.285	-0.079	-0.136	
Disapproval by Friends	-0.054	-0.127	-0.127		-0.144	0.086	0.115	
Role Models and Mentors	-0.122	0.006	0.007		0.008	-0.053	-0.055	
Networking Difficulty	-0.053	-0.170	-0.169		-0.149	0.219	0.248	
Administrative Support	-0.511***	-0.105	-0.100		-0.069	-0.185	-0.171	
Obtaining Finance	-0.092	0.197*	0.198*		0.135	-0.048	-0.075	
Identifying Stakeholders	-0.123	-0.046	-0.045		-0.356*	0.120	0.191	
Childcare-Work Conflict	0.242	-0.149	-0.151		-0.069	-0.130	-0.116	
Lack of Confidence	0.087	0.155	0.154		0.007	-0.160	-0.161	
Main Effects								
ESE			0.009	0.037			0.199	0.102
F-Statistics	2.316**	10.833***	10.140***	17.921***	2.103*	3.104**	3.156***	5.254***
Adjusted R^2	0.299	0.761	0.756	0.749	0.263	0.405	0.422	0.429

ESE refers to entrepreneurial self-efficacy; EI refers to entrepreneurial intentions;
t1 refers to pre-survey; t2 refers to post-survey
*p < 0.05; **p < 0.01; ***p < 0.001; Two-tailed Test.

Table 22 *Regression Results of Men Respondents* (N= 51)

Independent/Dependent Variables	ESE (t1)	EI (t1)			ESE (t2)	EI (t2)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	5.319***	1.934*	1.167	1.875***	4.194***	5.948***	4.872**	0.383
Controls								
Minority Background	-0.024	0.178	0.180	0.178*	-0.202	0.007	0.035	0.115
Married Status	0.013	-0.072	-0.073	0.023	-0.077	0.267	0.277	0.086
High Motivation	0.114	0.173	0.163	0.021	-0.155	-0.075	-0.055	-0.180
High Pre-EI	-0.106	0.737***	0.746***	0.816***	0.030	0.394*	0.390*	0.618**
Family Business	0.038	-0.064	-0.068	-0.029	-0.221	-0.015	0.014	0.203
Started a Business	0.135	0.112	0.101	-0.006	0.059	0.125	0.117	0.081
Worked in a Start-up	-0.104	0.036	0.045	0.135	0.016	-0.029	-0.031	0.059
Taught Modules	0.122	-0.207	-0.217	-0.172	0.153	0.019	-0.001	0.018
Workshops	-0.018	0.007	0.009	-0.012	-0.119	-0.001	0.015	0.063
Online Courses	0.008	0.251*	0.250*	0.238*	0.035	0.061	0.056	0.091
Business Plan Competition	0.136	-0.113	-0.124	-0.111	0.088	-0.367*	-0.379*	-0.362*
Main Effects								
Stereotype Threat	-0.302	-0.273	-0.248		0.131	-0.149	-0.166	
Sex Discrimination	-0.162	0.081	0.094		0.357	0.129	0.081	
Disapproval by Family	0.012	0.061	0.060		0.091	-0.297	-0.309	
Disapproval by Friends	-0.031	0.049	0.052		-0.146	0.139	0.158	

Independent/Dependent Variables	ESE (t1)	EI (t1)			ESE (t2)	EI (t2)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Role Models and Mentors	0.068	0.105	0.099		-0.245	-0.110	-0.077	
Networking Difficulty	0.045	0.111	0.107		0.067	-0.146	-0.155	
Administrative Support	-0.428*	0.237	0.273*		-0.443**	-0.208	-0.149	
Obtaining Finance	-0.063	0.049	0.054		0.372*	0.027	-0.023	
Identifying Stakeholders	-0.090	-0.185	-0.177		-0.290	0.123	0.162	
Family-Work Conflict	0.071	-0.204	-0.210		0.043	-0.113	-0.119	
Lack of Confidence	-0.143	0.159	0.171		-0.219	-0.400*	-0.371*	
Main Effects								
ESE			0.085	0.052			0.134	0.311*
F-Statistics	1.778	6.780***	6.396***	10.620***	2.061*	3.405**	3.253**	2.543*
Adjusted R^2	0.255	0.718	0.713	0.698	0.318	0.514	0.509	0.270

ESE refers to entrepreneurial self-efficacy; EI refers to entrepreneurial intentions;
t1 refers to pre-survey; t2 refers to post-survey
*p < 0.05; **p < 0.01; ***p < 0.001; Two-tailed Test.

6.6.5 The Influence of Predispositions on the EEC Impact

This section aims to test the following hypotheses: **Hypothesis 6**: "Following EEC attendance, participants with high Pre-EI demonstrate insignificant change in EI," **Hypothesis 7a**: "Prior entrepreneurial exposure positively influences Pre-EI of EEC participants," **Hypothesis 7b**: "Following EEC attendance, participants with prior entrepreneurial exposure demonstrate insignificant change in EI," and **Hypothesis 8**: "The higher the level of entrepreneurial motivation, the higher the level of Pre-EI of EEC participants." The Pearson correlations and dummy variables were employed to test these hypotheses. Results from **Table 23** show that participants who had high Pre-EI demonstrated significantly higher change in their EI following EEC attendance. However, there was no significant relationship between prior entrepreneurial exposure and change in EI of women and men participants. Results from **Table 24** indicate that women and men participants who had high entrepreneurial motivation demonstrated significantly higher EI. Women participants who had started a business, attended workshops in business and attended business plan competitions demonstrated higher Pre-EI than women participants who did not have such prior entrepreneurial exposure. Men participants who had worked in a start-up demonstrated significantly higher Pre-EI than men participants who had not. Therefore, **Hypothesis 7a and 8 are supported** while **Hypothesis 6 and 7b are not supported.**

Table 23 *Predispositions and Change in Entrepreneurial Intentions by Sex*

Change in Entrepreneurial Intentions	Women (M)			Men (M)			Diff. by Sex (Yes)	Diff. by Sex (No)	Impact Diff. by Sex+
	Yes	No	Diff.	Yes	No	Diff.			
High Pre-EI[1]	0.19	-0.62	**0.80*** **	0.29	-0.63	**0.92** **	-0.10	0.14	-0.24(.317)
Family Business	-0.38	-0.23	-0.15	-0.56	-0.09	-0.46	0.17	-0.14	0.31(.398)
Started a Business	0.00	-0.32	0.32	-0.50	-0.23	-0.27	0.50	-0.09	0.59(.298)
Worked in a Start-up	-0.20	-0.33	0.13	0.50	-0.36	0.86	**-0.70***	0.02	-0.72(.396)
Taught Modules	-0.06	-0.39	0.34	-0.36	-0.23	-0.14	0.31	-0.17	0.48(.455)
Workshops	-0.17	-0.37	0.20	-0.17	-0.30	0.14	-0.01	-0.07	0.06(.373)
Online Courses	-0.22	-0.32	0.09	-0.17	-0.27	0.10	-0.06	-0.05	-0.01(.485)
Business Plan Competition	-0.11	-0.33	0.22	0.40	-0.33	0.73	-0.51	-0.01	-0.50(.678)

[1]Pre-EI refers to pre-competition entrepreneurial intentions
+Obtained by Difference in Differences Analysis with Robust Standard Errors in Parentheses.
*p < 0.05., **p < 0.01. ,***p < 0.001

Table 24 *Predispositions and Pre-Competition Entrepreneurial Intentions by Sex*

Entrepreneurial Intentions (t1)	Female (M)			Male (M)			Diff. by Sex (Yes)	Diff. by Sex (No)	Impact Diff. by Sex+
	Yes	No	Diff.	Yes	No	Diff.			
High Motivation	3.97	2.28	**1.69*** **	4.11	2.44	**1.67*** **	-0.14	-0.16	0.02(.320)
Family Business	3.12	2.86	0.26	3.00	3.09	-0.09	0.12	-0.23	0.35(.447)
Started a Business	4.50	2.89	**1.60***	3.75	3.00	0.75	0.75	-0.11	0.86(.648)
Worked in a Start-up	3.53	2.83	0.70	4.17	2.91	**1.26***	-0.63	-0.08	-0.55(.509)
Taught Modules	3.39	2.84	0.55	3.09	3.05	0.04	0.30	-0.21	0.51(.554)
Workshops	3.52	2.72	**0.80** **	3.28	2.94	0.34	0.24	-0.22	0.46(.443)
Online Courses	3.67	2.88	0.78	3.67	2.98	0.69	0.00	-0.09	0.09(.530)
Business Plan Competition	3.78	2.87	**0.91***	3.40	3.02	0.38	0.38	-0.16	0.54(.690)

t1 refers to pre-survey
+Obtained by Difference in Differences Analysis with Robust Standard Errors in Parentheses.
*p < 0.05., **p < 0.01. ,***p < 0.001

6.7 Gender Implications that Arose from the Quantitative Findings

This section highlights gender implications that arose from the quantitative findings through paying particular attention to the EEC's impact on women participants. It begins by outlining the positive EEC impact upon EI and ESE of women participants. Subsequently, five gender barriers to entrepreneurship are identified based on the EEC's particular impact upon women. Finally, the section discusses other gender implications related to the relationships between perceived barriers, ESE, EI and predispositions of women participants.

6.7.1 Positive EEC Impact upon EI of Women Participants

Despite the Difference-in-Differences estimate suggesting no sex-based differences, there are gender implications regarding the EEC impact upon EI of women participants. Referring to Table 18 (page 92), following EEC attendance, women participants demonstrated significantly higher EI (mean diff. = 0.30, $p < 0.01$) whereas the competition did not significantly impact men participants' EI. This finding indicates a particularly positive impact of the competition on perceived EI of women participants.

6.7.2 Positive EEC Impact upon ESE in Finance and Cost Estimation of Women Participants

Even though the Difference-in-Differences estimate suggested no sex-based differences, there are gender implications regarding the EEC impact upon perceived ESE in finance and cost estimation of women participants. As shown in Table 19 (page 93), prior to EEC attendance, women participants demonstrated significantly lower confidence in finance (mean diff. = -0.42, $p < 0.05$) and cost estimation (mean diff. = -0.43, $p < 0.05$) than their male counterparts. However, these differences were no longer significant after the programme. These findings indicate that the competition had a positive impact on and potentially eliminated differences in perceived ESE in finance and cost estimation between women and men participants.

6.7.3 Particular EEC Impact upon Perceived Gender Barriers to Entrepreneurship of Women Participants

The EEC programme was found to influence the majority of perceived gender barriers to entrepreneurship of both sexes; however, women participants were more greatly affected. According to Table 20 (page 94), there are gender implications regarding the EEC impact upon five perceived gender barriers to entrepreneurship: (a) stereotype threat, (b) sex discrimination, (c) lack of role models and mentors, (d) networking difficulty and (e) childcare-work conflict.

1) Stereotype Threat

Prior to EEC attendance, women participants demonstrated significantly lower perceived barrier in stereotype threat than their male counterparts (mean diff. = -0.46, $p < 0.001$). However, following the EEC programme, there was no significant sex-based difference in perceived stereotype threat. The Difference-in-Differences estimate supports that the EEC impact upon perceived stereotype threat between both sexes is significant (robust standard errors = 0.172, $p < 0.01$). The findings imply that the EEC had a positive impact on perceived stereotype threat of women participants and, as a result, effectively eliminated sex-based difference in perceived stereotype threat.

2) Sex Discrimination

Following EEC attendance, both men (mean diff. = -0.62, $p < 0.001$) and women (mean diff. = -0.45, $p < 0.001$) participants demonstrated significantly lower perceived barrier in sex discrimination. The Difference-in-Differences estimate was not significant, supporting the similarity of this impact between both sexes. However, women participants still perceived a significantly higher barrier in sex discrimination than their male counterparts, and the difference was greater after EEC attendance (mean diff. = 1.01, $p < 0.001$). In other words, sex discrimination still acted as a gender barrier to entrepreneurship among women participants, following the EEC programme, despite the positive impact upon them.

3) Lack of Role Models and Mentors

Only women participants demonstrated significantly higher perceived lack of role models and mentors after attending the competition (mean diff. = 0.55, $p < 0.01$); indicating that the competition had a negative impact on perceived lack of role models and mentors among women participants.

4) Networking Difficulty

Prior to the competition, women participants demonstrated significantly higher perceived networking difficulty than their male counterparts (mean diff. = 0.51, $p < 0.01$). However, this difference was no longer significant after the competition. This finding indicates that the competition effectively eliminated sex-based difference in perceived network difficulty.

5) Childcare-work Conflict

Following the competition, both men (mean diff. = 0.51, $p < 0.001$) and women participants (mean diff. = -0.21, $p < 0.05$) demonstrated significantly lower perceived childcare-work conflict. However, women participants still perceived significantly higher childcare-work conflict than their male counterparts, and the difference was greater following the competition (mean diff. = 0.52, $p < 0.01$ from mean diff. = 0.21, $p < 0.05$). The Difference-in-Differences estimate supports that this sex-based difference was significant (robust standard errors= 0.144, $p < 0.05$). Despite this positive impact, childcare-work conflict still acted as a gender barrier to entrepreneurship among women participants.

6.7.4 Gender Implications regarding Factors Influencing ESE and EI

Referring to Table 19 and 20 (page 91), there are relevant gender implications regarding factors that influenced ESE and EI of women participants as follows.

1) Entrepreneurial Motivation and Entrepreneurial Intentions

It was found that ESE did not influence EI of women participants. Instead, their EI was significantly influenced by their motivation to start a business. Women participants with prior entrepreneurial motivation demonstrated significantly higher EI following the competition ($t = 0.433$, $p < 0.01$). This is in contrast to men participants whose EI was significantly influenced by perceived ESE ($t = 0.311$, $p < 0.05$). These findings indicate that women participants' EI was influenced by their entrepreneurial motivation rather than perceived ESE, while men participants would decide to start a business based on their perceived

capabilities to do so. In other words, an entrepreneurial opportunity seems to be more viable for men participants to pursue without having the necessity to develop strong passion towards entrepreneurship while women participants needed to demonstrate high entrepreneurial motivation in order to develop EI.

2) Marital Status and Entrepreneurial Intentions

Prior to the competition, marital status had negative influence on EI of women participants (t = -0.201, $p < 0.01$); however, this relationship was no longer significant following the competition. Meanwhile, men participants never perceived their marital status as a barrier that would hinder their EI. These findings imply that the competition eliminated the negative relationship between being married and EI among women participants and, as a result, married women participants no longer perceived their marital status as a barrier that would deter their EI following EEC attendance.

3) Prior Entrepreneurial Exposure and Entrepreneurial Intentions

There was a positive relationship between having attended a business plan competition and Pre-EI of women participants (t = 0.224, $p < 0.05$). However, this relationship was no longer significant after the competition. This finding implies that the competition potentially eliminated the difference between perceived EI of women participants who had attended a business plan competition and those who had not. However, having attended a business plan competition negatively influenced EI of men participants.

4) Perceived Stereotype Threat and Entrepreneurial Self-Efficacy

The competition reinforced the negative relationship between perceived stereotype threat and ESE of women participants (t = -0.370, $p < 0.05$). However, this negative relationship was not found among men participants. The findings imply that, following the competition, the competition deterred self-confidence in ESE of women participants who perceived a high barrier in stereotype threat.

Table 25 provides the summary table connecting the quantitative findings to the qualitative analysis.

Table 25 Connecting the Quantitative Findings to the Qualitative Analysis

<table>
<tr><td colspan="3">Research Question: To what extent does the EEC, as a vehicle of EE, influence perceived gender barriers to entrepreneurship, ESE and in turn EI of STEMM women ECRs?</td></tr>
<tr><td colspan="3">Objective 1: To investigate the extent to which the EEC programme impacts perceived gender barriers to entrepreneurship, ESE and EI of STEMM women ECRs</td></tr>
<tr><td>Hypothesis</td><td>Key Gender Implications</td><td>Scope of Qualitative Analysis</td></tr>
<tr><td>H1: Following EEC attendance, STEMM women ECRs demonstrate lower EI than their male counterparts (Not supported)</td><td>The EEC had a positive impact on EI of women participants.</td><td>Explore their experience before, during and after the EEC in relation to the pattern of their EI.</td></tr>
<tr><td>H2: Following EEC attendance, STEMM women ECRs demonstrate lower ESE than their male counterparts (Not supported)</td><td>The EEC had a positive impact on all aspects of ESE and eliminated sex-based difference in perceived ESE in finance and cost estimation of women participants.</td><td>Explore their experience before, during and after the EEC that influenced their perceived ESE particularly in finance and cost estimation.</td></tr>
<tr><td>H3: Prior to EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts (Supported)</td><td rowspan="3">The EEC had a positive impact on and eliminated sex-based difference in perceived stereotype threat and networking difficulty of women participants.

The EEC had a positive impact on but did not eliminated sex-based difference in perceived sex discrimination and childcare-work conflict.

The EEC had a negative impact on perceived lack of role models and mentors of women participants.</td><td rowspan="3">Explore their experience before, during and after the EEC that influenced their perceived gender barriers to entrepreneurship including:
a) stereotype threat
b) sex discrimination
c) lack of role models and mentors
d) networking difficulty
e) childcare-work conflict</td></tr>
<tr><td>H4a: Following EEC attendance, STEMM women ECRs perceive higher gender barriers to entrepreneurship than their male counterparts (Supported)</td></tr>
<tr><td>H4b: Following EEC attendance, STEMM women ECRs perceive lower gender barriers to entrepreneurship than their male counterparts (Not supported)</td></tr>
<tr><td colspan="3">Objective 2: To investigate to what extent perceived gender barriers to entrepreneurship influence ESE and EI of STEMM women ECRs</td></tr>
<tr><td>Hypothesis</td><td>Key Gender Implications</td><td>Scope of Qualitative Analysis</td></tr>
<tr><td>H5: ESE mediates the relationship between perceived barriers and EI of STEMM women ECRs (Not supported)</td><td>The EEC reinforced negative relationship between perceived stereotype threat and ESE of women participants following the competition.</td><td>Explore their experience before, during and after the EEC that influenced their perceived stereotype threat in relation to their perceived ESE.</td></tr>
<tr><td colspan="3">Objective 3: To investigate to what extent the potential impact of the EEC programme is influenced by individual predispositions</td></tr>
</table>

Hypothesis	Key Gender Implications	Scope of Qualitative Analysis
H6: Following EEC attendance, participants with high Pre-EI demonstrate insignificant change in EI *(Not supported)*	Women participants who demonstrated entrepreneurial motivation also demonstrated high EI after the EEC	Explore entrepreneurial motivation of women participants in relation to their EI *(to be included in the scope of analysis of H5).*
H7a: Prior entrepreneurial exposure positively influences Pre-EI of EEC participants *(Supported)*	The EEC had a *positive impact* on EI of women participants, particularly of those who had never attended an EEC.	*(to be included into H5's scope of analysis).*
H7b: Following EEC attendance, participants with prior entrepreneurial exposure demonstrate insignificant change in EI *(Not supported)*		
H8: The higher the level of entrepreneurial motivation, the higher the level of Pre-EI of EEC participants *(Supported)*	Women participants' EI was driven by entrepreneurial motivation rather than ESE.	Explore entrepreneurial motivation of women participants in relation to their EI *(to be included in the scope of analysis of H5).*

6.8 Summary

This chapter sets out the quantitative findings which indicate key interesting and surprising gendered results, for example, (a) the competition had a positive impact upon EI among women participants while their male counterparts demonstrated no significant change in their career intentions, (b) women participants demonstrated more significant change than their male counterparts in regard to their perceived gender barriers to entrepreneurship, (c) the EEC was found to reinforce the negative relationship between perceived stereotype threat and ESE among women participants while this was not the case among men participants, and (d) women participants' EI was more driven by their entrepreneurial motivation rather than their ESE. These gendered effects of the EEC programme upon female participants will be further explored in the next chapter which presents the qualitative findings drawing upon the semi-structured interviews with 45 women participants who attended the EEC programme.

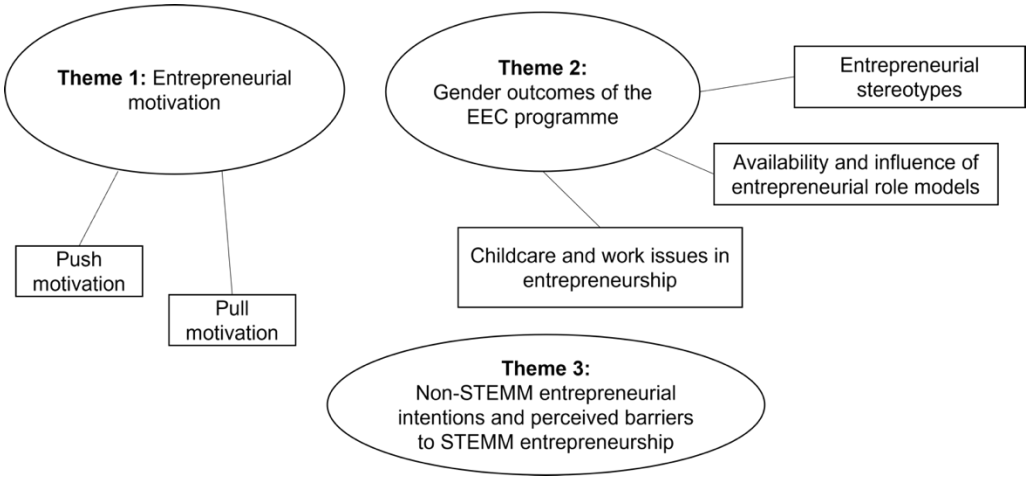
7. Qualitative Results

The preceding quantitative results chapter employed sex as a variable to explore the differences of the enterprise education competition (EEC) impact upon men and women STEMM ECRs in relation to perceived gender barriers to entrepreneurship, entrepreneurial self-efficacy (ESE) and entrepreneurial intentions (EI). It provides partial answers to the overarching research questions in regard to "What works for all participants?" and "What works and does not work for women participants?" However, the literature review has highlighted the need for entrepreneurial education (EE) research to explore the deeply embedded cultural and social cognitive associations that frame STEMM and entrepreneurship as masculine concepts (Jones and Warhuus, 2018) and how these ideas affect STEMM women ECRs' career interest, progression and retention, particularly within STEMM entrepreneurship (Kuschel *et al.*, 2020). Gender is a social construction (Oakley, 1972) and is being used as an analytical lens in this chapter to provide insight into the experiences, understandings and aspirations of the STEMM women who participated in the EEC and to understand the impact of the EEC upon their ESE and EI (Foss *et al.*, 2018). In addition, women participants are not a homogeneous group and the EEC programme in this thesis is viewed as a 'complex social programme' which generates *"different effects on different participants in different circumstances."* (Brentnall *et al.*, 2018b, p. 406). This chapter therefore explores the differential outcomes among women participants and what may attribute to these outcomes; providing insights into the EEC impact upon women participants, regarding "In what circumstances?" and "Why?"

Figure 11 illustrates the final thematic map showing final three main themes and their codes. According to the thematic analysis, three key aggregated themes emerged. The first theme considers entrepreneurial motivation of women participants – defined as 'push' and 'pull' entrepreneurial motivation. The second theme reflects how the EEC influenced women participants in three different aspects: (a) perceived entrepreneurial stereotypes, (b) perceived

availability and influence of entrepreneurial role models, and (c) perceived childcare and work issues in entrepreneurship. The final theme reveals their intentions towards starting a non-STEMM related business and their perceived barriers to STEMM entrepreneurship. Each of these key themes will be discussed in turn.

Figure 11 Final Thematic Map



7.1 Entrepreneurial Motivation of STEMM Women ECRs

The first theme explores prior entrepreneurial motivation and reasons to participate in the EEC programme of women participants. The thematic analysis revealed that most women participants expressed an interest in entrepreneurship as they had a business idea they would like to pursue in the future. In some cases, their interest in an entrepreneurial career was driven by various motives categorised in this thesis as 'push' and 'pull' entrepreneurial motivation. The former occurs when women perceived limitations, barriers and disadvantages in their traditional careers that influence them to consider an entrepreneurial career path (Byrne *et al.*, 2019; Marlow and McAdam, 2012). The latter is the motives to start a business that are not driven by necessity or structural barriers (Kelley *et al.*, 2017) but generally driven by the pursuit of profit, social impact and/or personal challenges (Dawson and Henley, 2012; Giacomin *et al.*, 2011). The following sections will discuss each type of entrepreneurial motivation in turn.

7.1.1 Push Entrepreneurial Motivation – Perceived Gender Barriers in Traditional STEMM Careers

The first code considers women participants' prior entrepreneurial motivation in relation to their perceived limitations, constraints, and disadvantages in their current and prospect traditional STEMM careers. In some cases, these perceived barriers were found to influence their interest towards entrepreneurship. The thematic analysis revealed that, as PhD and PostDoc students, women participants perceived the following gender barriers to their traditional STEMM careers: (a) conflict between work, life, and family plans, (b) gender bias within traditional STEMM careers, and (c) embedded entrepreneurial masculinity within STEMM academic culture.

First, the study revealed that perceived conflict between work, life, and family plans influenced women participants' interest in an entrepreneurial career and their participation into the competition. This is due to the long hours and contract-based work nature of a STEMM academic career. Tina described the nature of her lab work in the last year of her PhD:

> *"The last year of the PhD is quite a lot and I'm doing my lab work that requires me to be in often at weekends just because it's the nature of experiments"* (Tina).

Acknowledging that PostDoc contracts can be as short as six months, Mary struggled to visualise her future life plan:

> *"I know plenty of people that have six-month PostDoc contracts. How can you organise your life if you have a six-month contract?"* (Mary).

The temporary work nature of a STEMM academic career influenced women participants' concerns around their caring responsibilities and family relocation. Over two-thirds of the interviewees perceived conflict between their future childcare responsibilities and having STEMM academic jobs. Susan shared her concern:

> *"Academic contracts usually tend to be only two or three years. That's quite hard that you will take the leave for the whole year"* (Susan).

Accordingly, Susan would like to start a business to have control over her own time and schedule:

> "*I would like to work for myself. I want to have my own time management and be able to make my own schedule. It's also something that I really enjoy"* (Susan).

An entrepreneurial career is seen as a "Plan B" for young STEMM women academic researchers who perceive the conflict between childcare and work as a barrier to their STEMM career progression (Treanor, 2019). In addition, it is acknowledged that women tend to report push and pull motivation towards entrepreneurship (Dawson and Henley, 2012), as mentioned by Susan that she found entrepreneurship 'enjoyable' (pull entrepreneurial motivation) and 'flexible' for her future family plan (push entrepreneurial motivation). While men largely perceive an entrepreneurial motivation based on pull factors (Dawson and Henley, 2012), women tend to perceive push and pull motivation as an intertwined concept that cannot be clearly separated (Jayawarna *et al.*, 2013; Welter *et al.*, 2017).

One interviewee raised her concern regarding conflict between eldercare responsibilities, work and relocation:

> *"I've been thinking about when my parents are more elderly and maybe I have to take on some caring responsibilities for them, then how is that going to work if I have a job that means that every year or every two years I have to move somewhere else?"* (Christina).

Some interviewees needed to relocate due to their partner's jobs which influenced their interest in starting a business:

> *"I and my husband are living in two different places and that is a big issue. If I could start up a business, I can work from home"* (Ashley).

Some gender practices within the STEMM academia, such as the high demands for flexibility, mobility and long work hours, have significant impact upon academic career development of women scientists (Kuschel *et al.*, 2017). The necessity in having flexibility for family commitments has been one of the major reasons STEMM women left their STEMM careers (Fouad *et al.*, 2017). It is widely acknowledged that women may consider an entrepreneurial career when they experience institutional, structural barriers in their careers particularly when they experience a 'glass ceiling' or 'maternal wall' (Thébaud, 2015). They subsequently consider entrepreneurship as a '*Plan B*' or an alternative career for working mothers (Thébaud, 2015).

Second, women participants perceived gender bias within their traditional STEMM careers, including implicit cognitive bias and explicit discriminated behaviours. Most interviewees noticed the remarkably lower proportion of STEMM women particularly in leadership positions:

> *"There are many women in biology, but the very interesting thing is that all the PIs [principal investigators] in plant science are male"* (Alexia).
>
> "*So, there are more women in Masters and PhD but, as you go higher, the number of females drops" (Melody)*.

STEMM disciplines are male-dominated, and this has been acknowledged as a part of gender bias issues (Kuschel *et al.*, 2020).

The male-dominated environment within STEMM influenced how they perceived gender biases and constraints within STEMM careers, particularly perceived difficulty in networking.

> *"Male PIs [principal investigators] normally have male friends, right? So, if you're going to get a connection or something, you're most probable to have it if you have a friend in there"* (Lisa).
>
> "*You hear lots of stories about people who meet their collaborators over drinks at 4:00 AM at a conference. It's usually always like groups of men*

getting really drunk with this professor. Of course, women can do that too, but that often feels a little bit like intimidation" (Tina).

The dominant masculine culture, particularly the male-only network, has been established as a key barrier that precludes STEM women from pursuing a STEM career (Cheryan *et al.*, 2017). Consequently, women scientists perceived less of a sense of belonging and are less likely to develop mixed-sex professional networks (Cheryan *et al.*, 2017).

Some interviewees perceived the assumptions regarding gender bias in hiring, getting promotion and funding:

"If it's a job application, people tend to lean towards men and there are more men already in place" (Danna).

"*Now you [women] are being favourable, but when you want to go for a higher position, maybe it's when they [men] might believe that they are better than you" (Daisy).*

"Funding, they will discriminate women because I saw not many women principal investigators" (Ashley).

The gender bias issues these women participants faced resonate those of women entrepreneurs who face stereotypical belief as lacking commercialisation skills (Malmström *et al.*, 2017), resulting in their perceived greater difficulties in hiring (Wolff *et al.*, 2020) and accessing finance (British Business Bank, 2019).

In some cases, interviewees expected to face gender bias in future employment due to the stereotypes that associate women with maternal role and childcare responsibility:

"*If now I'm going to job interviews, they might think 'Oh, she's 25-26 years old, she will probably want to have kids'"* (Stella).

> *"Having children … people assume that you do want them and they will hire you or not depending on that too"* (Mary).

STEMM women face gender bias by employers associating women with primary childcarers making them less preferable for hiring (Bolzani *et al.*, 2021).

In addition, some women participants experienced forms of discriminated behaviours within STEMM careers. As Anabelle reflected:

> "*I had three disadvantages for their mind. I was a woman, I was young and I was a recent graduate. At the beginning, it was really hard to get people to respect you"* (Anabelle).

Her experience reflects gendered ascriptions of entrepreneurial masculinity within a traditional STEMM career which values 'male competence and legitimacy' and puts women scientists in a disadvantaged position, expecting them to prove their competencies (Treanor and Marlow, 2021, p. 122).

Melody shared an experience of inferior treatment:

> "*If there are more men in the room, they tend to not listen completely. When you present the whole case, someone said, 'Oh, so you want to say this or that.' Let me talk!"* (Melody).

Inferior treatment has been acknowledged as a structural barrier that causes STEMM women to advance in their careers (Cadaret *et al.*, 2017; Treanor and Marlow, 2021).

Third, there is an association between STEMM academic culture and the stereotypical entrepreneurial masculinity (Bolzani *et al.*, 2021; Cheryan *et al.*, 2017). Tina mentioned the uncompassionate working style of her supervisor:

> *"It's definitely my supervisor who doesn't give out praise very easily"* (Tina).

The continuedly critical feedback style was potentially passed down by her supervisor's own PhD experience:

> *"That's just his style. He said when he did his PhD in [a prestigious university], he had like a really tough supervisor. People would come out of meetings crying"* (Tina).

Melody and Mary pointed out that their men colleagues tended to be more confident than themselves and women colleagues:

> *"If I'm going to say something to a room full of people or a group of students, I make sure that it is right and don't say it out aloud unless I'm super confident about it. But, I've worked with male colleagues who have said something which they were still not very sure about"* (Melody).

> *"Guys often have an easier time giving out this perception that they're really good, really confident and really amazing, and that always helps them. It's very unlikely that women have that"* (Mary).

The nature of their men supervisors and colleagues reflects some dominant traits and characteristics associated with the masculine stereotypes of a prototypical entrepreneur, including 'confident' and 'detached' (Ahl, 2004). Women scientists associated the image of a successful entrepreneur with the stereotypical entrepreneurial masculinity, as someone who is self-confident (Bolzani *et al.*, 2021). They experience masculinised culture within the STEMM fields, where the typical masculine characteristics in men are preferable (Treanor and Marlow, 2021), and as a result, they perceived less of a sense of belonging and felt less suited to the masculinised STEMM culture (Cheryan *et al.*, 2017).

In summary, the findings in this code show that women participants perceived gender barriers within traditional STEMM careers which, in some cases, influenced their interest towards an entrepreneurial career and their participation in the competition. Women scientists face sex discrimination and

gendered assumptions in their professional STEMM environment which influences their interest towards entrepreneurship (Marlow and McAdam, 2015). They bear the stigma associated with a maternal role and caring responsibilities (Cadaret *et al.*, 2017). Accordingly, an entrepreneurial career is seen as a "Plan B" for young STEMM women academic researchers who perceive 'maternity threat' as a potential barrier to their STEMM career progression (Treanor, 2019). Most interviewees in this code planned their career based on perceived gender barriers (Cadaret *et al.*, 2017). However, there is another group of women participants whose entrepreneurial interest was largely influenced by entrepreneurial passion and aspiration rather than by perceived structural barriers in traditional STEMM careers. The following section will discuss women participants who were largely driven by pull entrepreneurial motivation.

7.1.2 Pull Entrepreneurial Motivation – Entrepreneurial Passion and Family Business Influence

The second code considers women participants' entrepreneurial motivation in relation to their entrepreneurial passion and prior family business exposure. According to the thematic analysis, women participants who reported 'pull' entrepreneurial motivation were driven by different reasons, including: (a) independence and flexibility, (b) entrepreneurial passion and personal challenges and (c) prior positive family business exposure.

First, women participants were attached to the independence and flexibility of an entrepreneurial career: *"If I owned my business, I could choose what I want to do and if I want to work with these people or not"* (Ashley). However, some interviewees sought independence and flexibility from entrepreneurship as they perceived conflict between work, life and family plans within a STEMM career. Despite wanting to have children, Danna decided to have an abortion in the first year of her PhD due to the pressure to do well and the assumed lack of maternal support from her university:

> *"I had an abortion. I had just started the PhD, right? Like five months. I didn't read through what happens if we get pregnant and if you want to keep the child and I didn't really check. But, I don't think they are particularly favourable"* (Danna).

She therefore would like to start a simple, small business to have flexibility for her children in the future: *"I would like an easier business with a smaller branch. I must be flexible all the time when I have children"* (Danna). Even though the desire for independence may 'pull' some women towards an entrepreneurial career, the search for independence and job flexibility is largely found to 'push' women towards entrepreneurship (Foley *et al.*, 2018; Kuschel *et al.*, 2020).

Second, women participants' entrepreneurial interest was driven by their entrepreneurial passion and personal challenges. Over one-quarter of the interviewees were interested in an entrepreneurial or commercialisation activity that creates positive impact to society and environment:

> *"Commercialising is a different thing. It's interesting. Something that I could have an impact on people and that I can help and improve people's life"* (Emma).

A few of the interviewees would like to start a business in the pursuit of profit, personal challenges, and social acceptance. Myra's entrepreneurial interest was primarily driven by financial return: *"I'm constantly thinking of how to make more money or investment"* (Myra). Linda perceived the hardship of entrepreneurship as fun and challenging: *"I see it [starting a business] as quite fun, but fun means challenging. I don't think there'll be all rainbows and candies"* (Linda). One of the reasons Melody would like to start a business is to gain appreciation from her friends and family:

> *"My other friends and relatives, they wouldn't understand what I do [in her PhD], but if I say that I did this [her business idea] and this is helping someone and this is the market and I'm making money on it, they would appreciate it more"* (Melody).

The pursuit of profit, social status, and personal development is reported as a key entrepreneurial motivation among university students in general (Giacomin *et al.*, 2011).

Third, positive prior family business exposure had a positive effect on the entrepreneurial aspirations of some women participants. There were 22 interviewees that reported having a family business background, half of whom mentioned seeing their family member(s) running a business as role model(s) that positively influenced their perception towards entrepreneurship. Alexia mentioned her business idea:

> "*It's an idea about reducing C0^2 that's being released in the atmosphere. It's a service business for big factories and companies, probably oil companies."* (Alexia).

Her experience of seeing her father running a business influenced her positive perceptions of independence, autonomy, and well-being which entrepreneurship can offer:

> "*My dad works for himself. He is able to decide his own fate. You don't have to deal with frustration and distress of [having] somebody else over your head. You can decide which things you want to do and which things you don't want to do. You feel freer and less stressed"* (Alexia).

Positive prior family business exposure is suggested to influence a more positive attitude towards entrepreneurship (Jayawarna *et al.*, 2014; Krueger, 1993; Kusumawardani and Albertus, 2020).

Despite the positive influence of family business exposure on entrepreneurial interest for these participants, the remaining 11 of the 22 interviewees reported a negative influence of their family business background. Witnessing their family member(s) running their business resulted in some women respondents saying they had no interest in pursuing entrepreneurship due to concerns around: (a)

the lack of work-life balance and (b) high risk and financial instability. As Lucy highlights:

> "*They're always really busy. My dad hasn't had like a weekend off in years. I don't really want that. I'd like to have a bit more of a work-life balance*" (Lucy).

Nicole associated her family's farming business with instability and high risk:

> *"Growing up on a farm would make me not want to start my own business because it is so variable. You never know what the weather is going to be, how your crops are going to grow"* (Nicole).

Being exposed to the constraints in family business and personal sacrifices imposed on their parents is one of the reasons students decide against an entrepreneurial career to avoid the responsibilities and pressures related to entrepreneurship (Zellweger *et al.*, 2011).

Despite women participants reporting different sources of 'push' and 'pull' entrepreneurial motivation, perceived structural barriers in their traditional STEMM careers crystallised as their main reason for aspiring towards an entrepreneurial career instead. In contrast, entrepreneurial passion and challenges influenced entrepreneurial interest for some women participants. Consequently, entrepreneurship was included as one of the potential alternative careers. This resulted in their participation in the competition to explore the nature of entrepreneurship and its possibilities. The next section will discuss their experience during the competition in relation to how they perceived entrepreneurship, its potential barriers and their perceived suitability to become an entrepreneur.

7.2 Gendered Outcomes of the EEC Programme

The second theme examines the influence of the gender construction women had regarding entrepreneurship and commercialisation activity and how the EEC programme influenced it. Women participants attended the competition with

different awareness and assumptions towards entrepreneurship. During the competition, they were exposed to various influencers (e.g. entrepreneurs, mentors, and EEC participants) and events which changed and/or reinforced their entrepreneurial attitudes. Given that most interviewees had a business idea they would like to pursue in the future, they reflected upon the competition and made sense of their suitability to an entrepreneurial career. The thematic analysis identified the competition impact upon these perceptions, categorised into three codes, including: (a) perceived entrepreneurial stereotypes, (b) perceived availability and influence of entrepreneurial role models, and (c) perceived childcare and work issues in entrepreneurship.

7.2.1 Perceived Entrepreneurial Stereotypes

The analysis revealed that the competition influenced how women participants perceived entrepreneurship in two opposing ways, through: (a) providing a realistic account of an entrepreneur and (b) reinforcing the masculinised image of a typical entrepreneur.

First, the competition provided a realistic account of what it meant to be an entrepreneur, diluting the stereotypical entrepreneurial image often held by women participants. Over one-third of the interviewees initially associated an entrepreneur with the stereotypical entrepreneurial image. Prior to the competition, perceiving entrepreneurship as male-dominated made Molly sceptical about the business world: *"I used to be a lot more sceptical about the business world that it's very male-orientated"* (Molly). She also associated an entrepreneur with a traditional image of a businessman: *"I think it used to be very much just a person in a suit"* (Molly). Celene associated entrepreneurs with middle-aged, white, tanned men living a luxury life: *"Middle-aged white men but they're, like, really tanned cause they go on holiday all the time"* (Celene). Her experience of perceiving herself unfit for the stereotypical STEMM fields influenced her perception of also being unfit for entrepreneurship:

> *"In science, I feel like I'm a young woman. I drink alcohol. I wear a lot of makeup. I like to bleach my hair. I'm not the stereotypical proper scientist.*

That would translate to business as well as being like 'Oh, you're just like a young girl who cares about your looks.'" (Celene).

In addition, mainstream media, such as TV shows, blockbuster movies and news, influenced their perceptions of a stereotypical entrepreneur. Influenced by Dragons' Den and Wolf of Wall Street, Christina joined the competition with a stereotypical view of entrepreneurship as male-dominated, and a successful entrepreneur as ruthless and reckless:

"Before, my only ideas of a business were from Dragons' Den or seeing movies where they're all very glamorised and very dramatic, like in Wolf of Wall Street. Before the competition, I felt like these successful businessmen have to be a bit ruthless and have recklessness, really hot-headed and just like 'Buy! Sell!'" (Christina).

An entrepreneur is generally associated with a white, middle-aged man who has masculine traits and characteristics, for example, assertive, decisive, dominant, competitive, aggressive, individualistic, ambitious and risk-taking (Ahl, 2004; Treanor and Marlow, 2021). Contemporary media still largely associates a successful male entrepreneur with "*driven personality, a high-status leisure activity, a supportive but invisible family, a focus on financial measures and a global outlook*" (Jernberg *et al.*, 2020, p. 211). These perceived masculine gender stereotypes potentially decrease women's own perceived ability to pursue entrepreneurial activities, particularly within the STEMM sectors (Hardin and Longhurst, 2016; Wieland *et al.*, 2019).

However, the competition provided a sex-balanced and less-threatening atmosphere for women participants. One-quarter of the interviewees found the competition environment to be less threatening than how they initially anticipated. During the competition, they observed a similar proportion of women to men participants and experienced fair treatment:

"*I think my view now is more realistic. The competition felt quite gender-neutral cause there was a good mix of men and women. Because there*

was a lot of other women there, it made me feel like we all just competed on the same position. I didn't feel like all the men look so confident and so good at what they are doing and the women looked really unconfident" (Christina).

"Almost all teams had women as CEOs. Even the ones that had only one woman, they were all CEOs. It was pretty amazing" (Emily).

The findings support Neumeyer's (2020) suggestion that a sex-balanced environment plays an important role in enhancing STEMM women's likelihood to engage in entrepreneurial activities as they find the environment less threatening.

Consequently, the competition demystified the concept of entrepreneurship and provided a sensible account of the realities of starting and running an enterprise. In other words, the competition diluted the dominant image of a stereotypical entrepreneur and added diverse perceptions regarding who could be an entrepreneur and what is an entrepreneur like? The entrepreneur talks demystified Claudia's perceived image of a successful entrepreneur as a born millionaire and an immediate businessperson:

"It's from the talk of people who had successful businesses. No one started as, like, a multi-millionaire. Most of them started a business quite late on in life. It doesn't necessarily have to be an immediate businessman" (Claudia).

Christina now realises that starting a business requires a lot of planning: *"Now, I realise just how much work and planning you have to put in"* (Christina).

Claudia also learned from the group work during the competition that entrepreneurship requires team effort and entrepreneurs rarely succeed by themselves:

"It was the group work that created the awareness that you're not doing it by yourself. You go into business with a number of partners. You're

never going to have to be an expert in every single side of it yourself. You've got the team collaboration" (Claudia).

Seeing a young entrepreneur speaker raised Blanca's awareness of young entrepreneurs:

> *"This guy that came to speak. He was 18 years old, but he was an entrepreneur. Maybe that age thing doesn't matter as long as you are really passionate about your business idea"* (Blanca).

Listening to a talk from a non-typical woman entrepreneur made Rosa believe that anyone can be an entrepreneur:

> *"So now, I think anyone could do it. [A woman entrepreneur] was really positive. You don't really expect a businessperson to have pink hair, but then you realise that it's such a stupid idea"* (Rosa).

Gender-sensitive entrepreneurship training can reduce negative stereotypes towards women entrepreneurship (Türko, 2016) and perceived mismatch between STEMM women's perceived entrepreneurial identity and the stereotypical masculinised image of an entrepreneur (Elliott *et al.*, 2020). This indicates that the EEC programme contains specific features/elements which address issues related to gender stereotypes in entrepreneurship. These specific elements are not limited to an exposure to women entrepreneurs (Byrne *et al.*, 2019), but a diverse set of speaker profiles in terms of sex, age and characteristics.

However, some women participants reported that the competition reinforced the stereotypical masculine image of an entrepreneur. Over one-quarter of the interviewees still associated an entrepreneurial image with someone who is very confident. Alexia was not impressed by three men participants who were overconfident:

> "*There were three men [other team members]. They were very strong. I didn't like [it] when they pitched actually because they were too confident for their abilities"* (Alexia).

Mary referred to a male entrepreneur speaker:

> *"An example would be [a male entrepreneur speaker]. He talked a lot about himself" (Mary).*

This influenced her negative perceptions towards an entrepreneur:

> *"You need to have a magnetic personality and be really good at bull**ting because you don't need to know anything about science"* (Mary).

In addition, some interviewees associated entrepreneurship with a profit-orientated business. A talk by a male entrepreneur made Nicole perceive an entrepreneur as someone who is profit-driven:

> *"Sometimes, I would see them as just looking for profit, but not necessarily looking to actually solve an actual problem, like what [a male entrepreneur] is doing"* (Nicole).

The stereotypical image of a successful entrepreneur in general is widely reproduced by media and entrepreneurship educators as a financially driven (Jernberg *et al.*, 2020), confident and charismatic individual (Jones and Warhuus, 2018).

To conclude, prior to the competition, women participants tended to have a masculine construction of the prototypical entrepreneur, influenced by their experience within STEMM academia and mainstream media. The competition was established to provide diverse exposure to entrepreneurs who are different from the typical entrepreneurial stereotypes in terms of sex, age, and characteristics. As a consequence, this is found to eliminate the stereotypical image of an entrepreneur. However, for some women participants, the competition still reinforced the stereotypical masculinised entrepreneurial

image, which was reproduced by entrepreneur speakers and competition participants. The following section will discuss the influence of the competition upon perceived availability and influence of entrepreneurial role models among women participants.

7.2.2 Perceived Availability and Influence of Entrepreneurial Role Models

During the competition, women participants were exposed to potential entrepreneurial role models, for example entrepreneurs, mentors, and competition judges. They observed their specific behaviours, styles, and attributes which they would or would not like to emulate. The analysis revealed that women entrepreneur speakers affected women participants in three different ways: (a) they provided entrepreneurial and career inspiration, (b) they reinforced negative stereotypes towards STEMM women entrepreneurs, and (c) they raised awareness of the underrepresentation of STEMM women entrepreneurs.

First, some women participants were particularly inspired by women entrepreneurs in terms of their entrepreneurial and career progression. Melody was motivated by a woman entrepreneur speaker who could relate her academic experience to a commercialisation opportunity:

> *"She talked about transferring from academia to industry, and that was brilliant… I already do so many things. I just have to translate them to something different which is more rewarding"* (Melody).

Seeing many successful women entrepreneurs during the competition eliminated Lisa's perceived difficulty in starting a business:

> *"There were so many successful females around and they were so properly recognised. It feels like it's not going to be like science. In business, it feels like it's much easier for some reason"* (Lisa).

Ruth was inspired by a woman speaker who made her aware of an 'entrepreneur-in-residence' as an alternative career path in entrepreneurship:

> *"I really liked the finance woman who had the good job title of 'entrepreneur in residence'. She sounded like she had a really good career journey"* (Ruth).

Women entrepreneurial role models are found to provide significant support for women's decision to pursue non-traditional careers through influencing their entrepreneurial attitude, capabilities, and interest (Austin and Nauta, 2016).

In addition, women participants were inspired by male entrepreneurial role models relating to their entrepreneurial and career aspiration. As Mila described:

> *"I got inspired by [a male entrepreneur speaker] who didn't know if he wanted to do a PhD. Then, he went into [an accelerator programme]. He's very inspiring"* (Mila).

Emily's career aspiration was inspired by a men practitioner who shared the same scientific background:

> *"He is a chemist or pharmacist. He did an MBA. Now, he works in something more related to finance and that was interesting...I relate to him due to my pharmaceutical background"* (Emily).

Some women participants admired men entrepreneurs who did not represent the stereotypical image of a masculinised entrepreneur. Cindy appreciated a men entrepreneur speaker who was ethical, intellectual but not overconfident:

> *"I really like [a male entrepreneur speaker]. You could tell he had integrity. He was obviously very intelligent. He didn't seem to have a huge ego. He seems cunning as well which is good"* (Cindy).

Women are more likely to admire male role models when they may share similar traits and characteristics (Wohlford *et al.*, 2004). As an example, Emily was inspired by a young male entrepreneur:

> *"It was very interesting to hear about [a business idea] because he's extremely young and he just finished his MSc but he thought of an idea and then he put it into practice. That's actually inspirational"* (Emily).

Emily could identify or relate to this guest speaker because they were both of a similar age and at a similar, early career stage. Regardless of sex, inspiring role models are found to influence entrepreneurial interest of women university students (Nowiński and Haddoud, 2019).

However, some women entrepreneurs influenced the negative stereotypical image of a STEMM women entrepreneur as being defensive, superficial and lacking in management skills. Cindy, for example, had a negative experience with a woman entrepreneur which, in turn, negatively influenced her perception towards women entrepreneurship:

> *"I asked a question to [a woman entrepreneur] and she was quite strong into our answer. That again made me think 'F***, if I want to be a CEO, do I have to be like this?' like I can't"* (Cindy).

> *"Her answer was really defensive and her language was combative. She challenged why I was asking the question in a way that made me feel embarrassed and I then assumed I had asked a really stupid question"* (Cindy).

Some women entrepreneurs align themselves with the image of a typically masculine '*agentic entrepreneur*' (Byrne *et al.*, 2019) through being aggressive, assertive and confident (Eagly and Johannesen-Schmidt, 2001).

A woman entrepreneur simplifying her start-up experience made Lucia sceptical about her business:

> *"She made it sound easy. It is really inspiring to see and listen to her, but, in my opinion, it's like their companies are the exception and not really very realistic"* (Lucia).

Some women entrepreneurs adopt an individualised entrepreneurial femininity by portraying themselves as an '*entrepreneur superwoman*' (Byrne *et al.*, 2019) who can overcome and often deny any obstacles (Lewis, 2014).

Another woman entrepreneur who shared her honest but negative experience in staff management made Alexia perceive that she lacked management skills:

> *"I didn't like the way [a woman entrepreneur] said that they haven't found a way to actually work with people… five people, it's too much. It means you have to work on something"* (Alexia).

According to these findings, women entrepreneurs perpetuated the traditional entrepreneurial stereotypes and, as a result, highlighted STEMM women entrepreneurs in a disadvantaged position (Byrne *et al.*, 2019).

In addition, some women participants reflected on the underrepresentation of women STEMM entrepreneurs as they observed a lower proportion of women speakers, mentors and competition judges:

> *"A lot of the mentors are male. I realise actually, in the business, there are a lot more males than females"* (Crystal).

> *"The [competition] judges, except the one lady, are all men. As you go higher up, they are all men"* (Whitney).

Women role models can produce a limited effect on women's career decisions in science, as they may instead raise awareness regarding the underrepresentation of women scientists (Breda *et al.*, 2018).

In summary, women entrepreneur speakers are found to influence entrepreneurial and career aspiration for some women participants. In some cases, they instead reinforced negative stereotypes towards STEMM women entrepreneurs. In addition, the underrepresentation of women entrepreneur speakers within the EEC programme was found to influence women participants' awareness regarding the general underrepresentation of STEMM women

entrepreneurs. However, there is a notion that inspiring men entrepreneurs can generate just as positive effects upon entrepreneurial and career aspirations for some women participants. The subsequent section will discuss the impact of the competition upon perceived childcare and work issues in entrepreneurship among women participants.

7.2.3 Perceived Childcare and Work Issues in Entrepreneurship

Prior to the competition, most women participants perceived and/or were aware of the conflict between their future work, life and family plans in their traditional STEMM careers. In some cases, this perceived conflict influenced their interest towards entrepreneurship and their participation in the competition. Throughout the competition, they constantly made sense and evaluated their views towards entrepreneurship in relation to their future work, life, and family commitments. The analysis revealed that, following the competition, the interviewees perceived entrepreneurship, in three different ways, as: (a) a time-demanding career, (b) a risky career, and (c) a flexible career for working mothers.

First, over one-third of women participants ended up perceiving entrepreneurship as a time-demanding career for working mothers. The intensive three-day business plan competition as well as listening to entrepreneur speakers made them realise that starting a business requires a high level of commitment and overtime work which would affect their future family plans:

> *"It's the demands of being an entrepreneur. I think it'll definitely affect your family life. When you see all the case studies, they really devote their whole time like [a male entrepreneur speaker] who moved to [another country] within two weeks"* (Mila).

Melody shared her experience hearing her woman teammate discussing a family matter with her partner over the phone at midnight during the competition:

> *"I shared my room with [a woman team member]. She had a call from her husband discussing buying new school shoes for the kids at midnight. I would have been like, whatever the f***, do whatever you want"* (Melody).

She therefore perceived conflict between future work and childcare as a barrier to entrepreneurship:

> *"When it comes to a business and someone wants a meeting with me, let's say at 7pm and I can't make it because I have family commitments or have kids. They might not want to work with me"* (Melody).

Women participants viewed entrepreneurship as similar to how women STEMM students view STEMM academia as a "*greedy institution"* that requires devotion (Hughes *et al.*, 2017). Women scientists still largely face double burden as they undertake a disproportionate share of domestic responsibility and childcare in addition to their professional responsibilities (Hughes *et al.*, 2017; Marlow and McAdam, 2012).

Second, five women participants perceived entrepreneurship as a risky career following the competition. Through their experience during the competition and the entrepreneur talks, they associated entrepreneurship with financial risk and high stakes which could affect financial stability of their future family:

> *"We had the talk from the guy who had the graph of the ups and downs. When you've got a family, you've got to consider that if you're starting a business. If it goes wrong, then you're not going to have income. I'd rather have a stable contract job"* (Ruth).

> *"I was a finance advisor [during the competition]. I realised it's a very steep curve to get to the point where you actually earn something and, with my children, I wouldn't be able to wait 10 years"* (Diana).

Some entrepreneurship courses are found to increase perceived risk of students towards entrepreneurship (Efrata *et al.*, 2021; Westhead and Solesvik, 2016)

and may encourage students who perceived higher risk to become more realistic regarding an entrepreneurial career (Oosterbeek *et al.*, 2010).

Third, some women participants perceived entrepreneurship as a flexible career which is suitable for their future work and family plans. Prior to the competition, Tina perceived the societal pressure which forced her to conform to social mothering expectations:

> "*Those barriers in terms of having to take time out but also societal pressures to be some way as a mother and spend a certain amount of time with your children"* (Tina).

Following the competition, Tina learnt that an entrepreneur could decide on their own exit strategy earlier than she realised. She therefore perceived an opportunity to take part in entrepreneurship while working in STEMM academia:

> *"Something I hadn't realised before the competition was how quickly businesses can turn over. You can exit the business within five years. You could start a business, especially if you also work in academia. It doesn't have to be forever and that can be quite a successful thing to do for a while and then stop doing it and then go back to it again"* (Tina).

Entrepreneurship is perceived as a more flexible career option among working mothers or women who perceived conflict between childcare and work within their traditional careers (Byrne *et al.*, 2019; Thébaud, 2015; Welter *et al.*, 2017). In some cases, training in economics and management provides understanding regarding expected return on entrepreneurial investment for women STEM graduates which, in turn, increases their probability to engage in an entrepreneurial activity (Piva and Rovelli, 2021).

In addition, there are other reasons women participants reported in relation to their future work and family plans. Some of them were already aware of the conflict between childcare and work in entrepreneurship: *"I don't think it's necessarily competition-based. I think it's just being realistic. I want to have kids*

so I'm going to be having tough time out" (Claudia). Some of them did not plan to have children in the future and therefore did not perceive any barrier in this regard: *"I don't want to have kids"* (Emily). As none of the entrepreneur speakers mentioned their experience in childcare while starting a business, Nicole assumed that there might be a problem around childcare and work issues among women entrepreneurs:

> *"It wasn't really mentioned or talked about, [the fact that a] business takes over your life when you try to start one. So, I just assumed there would be an issue with that [having a child while starting a business]"* (Nicole).

Finally, not having been exposed to a woman entrepreneur speaker made Daisy question the ability to juggle childcare and entrepreneurial endeavours: *"Everybody who came to talk about startups, they were all men. So, I think it's tricky for a woman, if you have kids"* (Daisy). Within the context of the competition, there was at least a proportionate representation of women as speakers who could act as role models. However, as women are underrepresented within this sector generally, subsequently there were significantly more men than women as speakers and judges, which underscored the masculinised nature of STEM entrepreneurship for some women participants. The underrepresentation of STEMM women entrepreneurs (Breda *et al.*, 2018) as well as the unaddressed issues around childcare-work life of an entrepreneur potentially reinforced the assumptions that STEMM women entrepreneurs with childcare responsibilities are in a disadvantaged position or discriminated against.

In summary, the competition deemed positive results, for some women participants, in influencing positive perception towards entrepreneurship as a flexible career for working mothers. However, over one-third of women participants latterly perceived higher conflict between their future work and childcare plans as they associated entrepreneurship with high risk, a high level of commitment and long work hours. Despite the proportionate representation

of women entrepreneur speakers presented during the competition, the general underrepresentation of STEMM women entrepreneurs as well as the overlooked issue around childcare-work life of an entrepreneur during the competition reinforced the assumptions that STEMM women entrepreneurs with childcare responsibilities are in a disadvantaged position or are discriminated against. The next section will discuss the last theme, revealing intentions to start a non-STEMM business and other perceived barriers to STEMM entrepreneurship of women participants.

7.3 Intentions to Start a Non-STEMM Business and Perceived Barriers to STEMM Entrepreneurship

The third theme considers intentions to start a non-STEMM business and perceived barriers to STEMM entrepreneurship of women participants. It was observed that over one-third of women participants were interested in pursuing a non-STEMM business, particularly a small, lifestyle business or a social enterprise: *"They are not hotels, but they are in the countryside in a farm… something related to agriculture and tourism"* (Vivian); *"I always wanted to start a food truck or something small"* (Tiffany); *"I would like an easier business with smaller branches"* (Danna); "*Something small and light but [that] changes the world. I couldn't see myself being comfortable with pure scientific business"* (Rosa).

Robyn, who was pursuing a PhD in agriculture, would like to start an environmental-friendly flower business for weddings:

> *"To be growing seasonal flowers in pots. My market would be weddings so it's environmentally friendly"* (Robyn).

Despite recognising a commercialisation opportunity in the agricultural industry, she was personally not interested in starting a technology-based agricultural business:

> *"The only thing I see possible is to collaborate with engineers where I need to develop a particular tool to measure something. But, I don't feel like I will have a passion for that"* (Robyn).

These interviewees perceived several barriers to traditional, high-growth STEMM entrepreneurship, including: (a) the lack of their competitiveness in the respective market, (b) the lack of suitable business opportunities, (c) the financial pressure in its nature, (d) the complication of the business process and (e) the need to be flexible for future family plan. Lucia perceived starting a business in molecular biology as highly competitive with high barriers to entry:

> "*Because of the competitors in the field, in molecular biology, there are super huge companies that will be doing that business development. Me on my own, I couldn't go against them because I don't feel like there is an opportunity to develop a business*" (Lucia).

Rosa perceived the lack of knowledge and skills to manage people and industrial technology: *"I don't feel knowledgeable enough to involve different people and a big machine"* (Rosa). Cindy could not bear the pressure of starting and running a business: *"It's a big responsibility. I don't want to push myself and have the slightest amount of panic. So, I don't want to own a business"* (Cindy).

It is acknowledged that opportunity identification is the most influential determinant to technological entrepreneurship intention for both STEM men and women (Armuña *et al.*, 2020). For STEM women, their perceived ability to identify a technology business opportunity is largely influenced by their perceived self-efficacy to start a technology venture (Neill *et al.*, 2015). Considering that women tend to report lower self-efficacy in the domains that are incongruent to their biological sex, it is likely that women scientists are less likely to recognise a STEM business opportunity and, subsequently, to develop intentions to start a business in such field (Wieland *et al.*, 2019). As a result, STEMM women tend to perceive themselves as not suitable to run a high-growth venture (Gupta *et al.*, 2019).

Danna would like to be flexible when she had children: *"I have to be flexible all the time when I have children"* (Danna). Work-family conflict has been identified as a barrier for STEM women to engagement in entrepreneurial and commercialisation activities (Fox *et al.*, 2011). Some women perceived themselves as a primary child carer and are expected by society to conform to social mothering expectations (Marlow and Swail, 2014). As a result, they are more likely to engage in a small enterprise for personal profit, value (Marlow and Swail, 2014) and childcare flexibility (Thébaud, 2015).

7.4 Summary

This chapter provides insights into the influence of gender upon the EEC programme upon women participants in relation to their perceived gender barriers, entrepreneurial capabilities, and interest. It draws upon the thematic analysis of semi-structured interviews with 45 women EEC participants. The following insights from three themes were discussed. First, prior entrepreneurial motivation of women participants was driven by various sources of push and pull motivation, including: (a) perceived gender barriers within their traditional STEMM careers, (b) entrepreneurial passion and aspiration, and (c) prior positive family business exposure. Second, the competition was found to reduce their perceived gender barriers to entrepreneurship through: (a) eliminating the stereotypical entrepreneurial image, (b) providing exposure to inspiring entrepreneur role models, and (c) highlighting entrepreneurship as a flexible career path for working mothers. Third, despite the positive impact, the competition still negatively influenced perceived gender barriers for some women, through: (a) reproducing the stereotypical masculinised entrepreneurial image, (b) reinforcing negative stereotypes towards STEMM women entrepreneurs, (c) raising awareness of sex-imbalance within STEMM entrepreneurship and (d) increasing perceived conflict between future childcare and work plans. Finally, over one-third of women participants associated their interest in entrepreneurship with a small lifestyle business rather than a traditional high-growth STEMM business, as they perceived: (a) the lack of competitiveness in the respective market, (b) the lack of suitable business

opportunities, (c) the financial pressure in its nature, (d) the complicated business process and (e) the need to be flexible for a future family plan. The findings presented in this chapter reflect the deeply embedded cultural and social associations that frame STEMM and entrepreneurship as masculine constructions and reveal how these constructions influence STEMM women's career aspirations, particularly in relation to STEMM entrepreneurship and commercialisation. The next chapter will synthesise and analyse the quantitative and qualitative findings presented, contributing to answering the research question at the core of this thesis.

8. Discussion

8.1 Introduction

The reported gender gap in commercialisation and innovation, such that fewer women than men engage in the commercialisation of scientific research, has been problematised due to a notional deficit to the national economy (NAO, 2018; WES, 2018). Concurrently, research exploring the impact of entrepreneurial education (EE) upon the entrepreneurial self-efficacy (ESE – belief one can establish a successful business) and entrepreneurial intentions (EI – the intention to actually engage in such entrepreneurial activity) of women has had mixed results. While research exploring gender and EI suggests EE programmes can increase EI of students, particularly among women (Nowiński *et al.*, 2019; Wilson *et al.*, 2007), some gender and EE scholars suggest that EE may be characterised by the same masculine construction as entrepreneurship and the enterprise discourse (Jones and Warhuus, 2018) which may dissuade women's engagement in entrepreneurial activity. This is said to be particularly the case for women in STEMM disciplines due to the 'double masculinity' (Kuschel *et al.*, 2020) of STEMM entrepreneurship.

Meanwhile, policymakers have promoted enterprise education competitions (EC/EACEA/Eurydice, 2016; QAA, 2018) as a good practice vehicle for EE delivery. However, there are concerns that a competitive format may suit those more accustomed to such masculine stereotyped behaviour (Jones and Warhuus, 2018). This has pointed towards the important role of perceived gender barriers to entrepreneurship (barriers related to women's pursuit of entrepreneurship as a career choice based upon their sex), as a critical factor influencing women's EI (Laguía *et al.*, 2022) and a key impact measure of EE (Jones and Warhuus, 2018). Drawing upon these various strands of research, we identify a research gap surrounding knowledge of the impact of an EEC upon STEMM women's perceived gender barriers to entrepreneurship, ESE and EI and whether such offerings may be inherently and unintentionally masculine.

This thesis explores the influence of an EEC upon perceived gender barriers to entrepreneurship, ESE and EI of STEMM women early career researchers (ECRs). It challenges the status quo reproduced by mainstream research regarding the assumed benefits of entrepreneurial education (EE) in effectively enhancing women's ESE and EI. Instead, it is argued that structural issues, rather than essentialist deficiencies among the women themselves, underpin differential participation rates in STEMM innovation within academic and industry employment environments, with consequential effects for women's STEMM self-employment. The research has been informed by, and employed, a critical realist approach to explore the heterogenous EEC impact upon women participants.

This thesis aims to address the following research question:

> *To what extent does the EEC, as a vehicle of EE, influence perceived gender barriers to entrepreneurship, ESE and in turn EI of STEMM women ECRs?*

The following research objectives were set out:

1) To investigate the extent to which the EEC programme impacts perceived gender barriers to entrepreneurship, ESE and EI of STEMM women ECRs;
2) To investigate to what extent perceived gender barriers to entrepreneurship influence ESE and EI of STEMM women ECRs, and;
3) To investigate to what extent the potential impact of the EEC programme is influenced by individual predispositions.

To answer the overarching research question, a quantitative study was employed to compare the EEC impact upon perceived gender barriers to entrepreneurship, ESE and EI between men and women participants. It also tested the relationships between these key constructs and the influence of individual predispositions upon the potential EEC impact. Subsequently, qualitative interviews were undertaken to gain insights into the differential EEC

impacts upon women participants. This chapter will analyse and link these findings and their contributions to established literature.

8.2 Critical Realist Approach: Exploring the Gender and EEC Phenomenon

This thesis adopted a critical realist approach in exploring the gender and EEC phenomenon. Critical realism (CR) accepts the views towards gender as biological sex and social constructed meanings (Archer, 2000). Through a realist EE approach, the EEC, in this thesis, is viewed as a 'complex social programme' which generates different outcomes for different participants under different circumstances. This allows the thesis to explore gender as a variable (sex) and disaggregated data as well as to assume the heterogeneous impact of the EEC programme among women participants. Accordingly, this thesis employed Explanatory Sequential Design (QUAN → Qual)[10] through 120 pre- and post-surveys of men and women EEC participants followed by semi-structured interviews of 45 women participants. Given that the focal EEC of this thesis (YES 2019) was designed to enhance the commercialisation knowledge and communication skillset among UK STEMM ECRs, the quantitative findings posited that the EEC programme largely yielded positive impact upon the participants through decreasing the number of perceived gender barriers to entrepreneurship as well as increasing ESE and EI of both sexes. However, the qualitative study revealed deeply embedded cultural and social associations that frame STEMM and entrepreneurship as masculine constructions and outlined how these constructions influenced STEMM women's career aspirations, particularly in relation to STEMM entrepreneurial and commercialisation activity.

[10] Explanatory Sequential Design is "*a mixed methods design in which the researcher begins by conducting a quantitative phase and follows up on specific results with a subsequent qualitative phase to help explain the quantitative results*" (Creswell and Plano Clark, 2018, p. 133). The 'QUAN → Qual' symbol indicates that the thesis initially conducted the quantitative study followed by the qualitative study.

To analyse the quantitative and qualitative findings, this thesis employed the 'retroductive' mode of analysis to facilitate the identification of plausible explanation and causal mechanisms in regard to the EEC outcomes upon STEMM women ECRs. Accordingly, the thesis is able to provide suggestive/indicative but fallible EEC outcomes upon STEMM women ECRs for this EEC cohort that may resonate with STEMM women undertaking similar EEC programmes with similar cohort characteristics. As a result, this thesis contributes to the feminist inquiry by recognising the heterogeneous EEC impact upon STEMM women ECRs; enhancing the accuracy and ability to produce in-depth outcomes of EE studies. It also advances the debates in gender and EE regarding the assumed benefits of EE programmes in enhancing ESE and EI of women by pointing towards perceived gender barriers to entrepreneurship and structural constraints as factors influencing women's ESE and EI as well as EE impact measures. The next section will discuss how employing Social Cognitive Career Theory facilitates the thesis' exploration of EI and the EEC impact upon EI of women participants.

8.3 Using Social Cognitive Career Theory to Explore Entrepreneurial Intentions

Within this thesis, Social Cognitive Career Theory (SCCT) was drawn upon as part of the theoretical framework to explore the EI of women within the STEMM professions (Fouad and Santana, 2017; Lent *et al.*, 2018). The framework recognises the complexity of social reality and the influence of context upon an individual's career intentions (Belchior and Lyons, 2022), particularly perceived barriers and support (Lent *et al.*, 2018) which was reconceptualised in this thesis as socio-cultural factors – structural barriers, namely 'perceived gender barriers to entrepreneurship' (Shinnar *et al.*, 2012). Within this thesis, eleven perceived gender barriers to entrepreneurship were identified: (1) stereotype threat, (2) sex discrimination, (3) disapproval by friends, (4) disapproval by family, (5) lack of role models and mentors, (6) networking difficulty, (7) lack of administrative support, (8) difficulty in obtaining finance, (9) difficulty in identifying stakeholders, (10) childcare-work conflict, and (11) fear of failure. In addition, SCCT recognises individual predispositions as critical factors influencing differential EEC impact upon EI of EEC participants. These factors include prior

entrepreneurial motivation, prior entrepreneurial exposure and prior entrepreneurial intentions. Thus, adopting SCCT allows this thesis to explore the development of EI through considering individual-based factors (ESE), contextual influence (perceived gender barriers to entrepreneurship) and personal inputs (individual predispositions). This operationalisation allows the thesis to facilitate a multidimensional understanding of the factors influencing the formation of EI among STEMM women ECRs, both before and after EEC participation.

Figure 12 *Key Discussion Areas Based on Social Cognitive Career Theory*

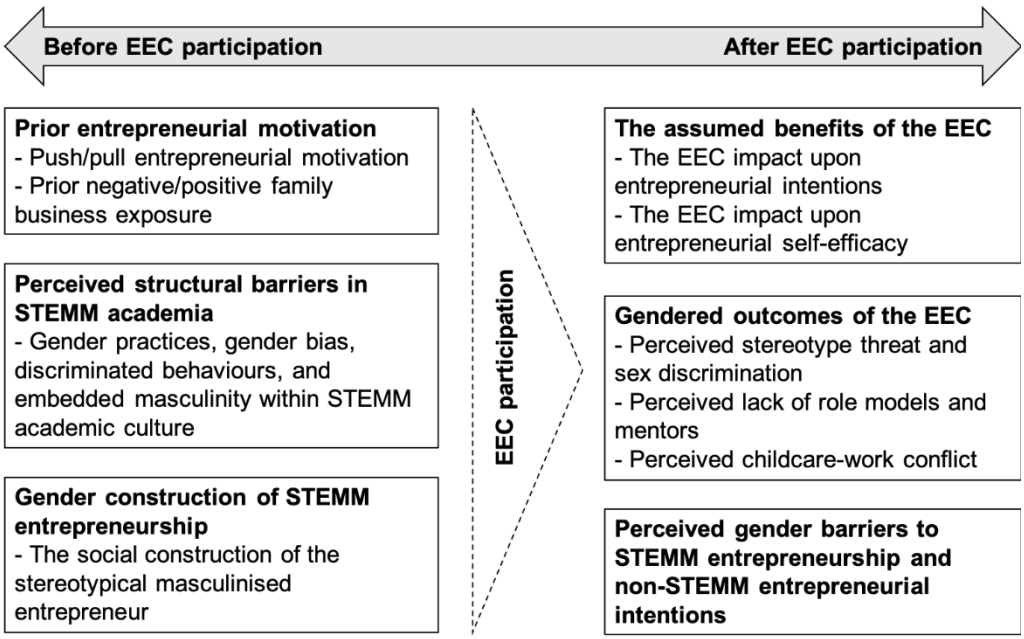


Figure 12 presents six key discussion areas reflecting gendered experience related to perceived gender barriers, ESE and EI of STEMM women ECRs before and after EEC participation. The discussion begins by discussing prior entrepreneurial motivation of women participants. It then discusses how the gendered nature and perceived gender barriers within STEMM academia influenced their interest towards entrepreneurship and EEC participation. Then, the gendered construction and assumptions towards STEMM entrepreneurship prior to EEC participation is discussed. Subsequently, the findings in relation to the EEC impact upon EI, ESE and perceived gender barriers to entrepreneurship are discussed. The last discussion area is related to the findings regarding

women participants' perceived gender barriers to STEMM entrepreneurship and non-STEMM entrepreneurial intentions.

8.4 Prior Entrepreneurial Motivation

The quantitative and qualitative findings indicated that most women participants took part in the EEC because they had a business idea that they would like to pursue in the future. Their interest in starting a business was categorised into two types of motives, namely 'push' and 'pull' motivation. Regarding 'push' motivation, women participants developed motivation to start a business as they perceived limitations, constraints, and disadvantages in their current and prospective traditional STEMM careers. Over two-thirds of interviewees perceived conflict between work, life, and family plans. Some of them experienced gender bias within traditional STEMM careers and embedded entrepreneurial masculinity within STEMM academic culture. This provides an explanation to the quantitative finding that women participants reported significantly higher motivation to EEC participation to identify potential alternative careers. The analysis around perceived structural barriers women participants experienced in their traditional STEMM careers will be discussed further in Section 8.5.

Regarding 'pull' motivation, over one-quarter of the interviewees' entrepreneurial interest was largely influenced by: (a) the pursuit of independence and flexibility, (b) the pursuit of profit, social status and personal challenges, as well as (c) prior positive family business exposure. The findings support previous literature regarding generic entrepreneurial motivation, for financial returns, social status and personal challenges (Giacomin *et al.*, 2011), as well as the influence of positive prior family business exposure on entrepreneurial interest of university students (Krueger, 1993; Kusumawardani and Albertus, 2020). However, some women participants seeking independence and flexibility, which they perceived entrepreneurship provided, reported both 'push' and 'pull' motivation; supporting previous research highlighting that women tend to perceive push and pull motivation as an intertwined concept

that cannot be clearly separated (Jayawarna *et al.*, 2013; Welter *et al.*, 2017). The search for independence and job flexibility is largely found to 'pull' women scientists towards entrepreneurship (Foley *et al.*, 2018; Kuschel *et al.*, 2020).

Drawing upon the qualitative findings, exposure to family business was found to influence women participants in two opposing ways. Eleven out of 22 interviewees who reported having a family business background, reported a negative influence of their family business background upon their entrepreneurial interest. They associated their family business with the lack of work-life balance, high risk and financial instability. This supports the entrepreneurship literature highlighting that being exposed to the constraints in family business and personal sacrifices imposed on their parents is one of the reasons students decide against an entrepreneurial career to avoid the responsibilities and pressures related to entrepreneurship (Zellweger *et al.*, 2011). On the other hand, the other 11 interviewees saw their family member(s) running a business as role model(s) that positively influenced their perception towards entrepreneurship, as Alexia highlighted: "*My dad works for himself. He is able to decide his own fate… You feel freer and less stressful*" (Alexia). Positive prior family business exposure is suggested to influence a more positive attitude towards entrepreneurship (Jayawarna *et al.*, 2014; Kusumawardani and Albertus, 2020).

Using the SCCT framework, this thesis demonstrates that most women participants had developed an interest in entrepreneurship, prior to EEC participation, which subsequently influenced them to attend the EEC programme to explore the nature and possibility of entrepreneurship as an alternative career. However, their interest towards entrepreneurship was largely influenced by perceived structural barriers they experienced within STEMM academia, rather than the pursuit of profit, social status and personal challenges and/or family business influence. These structural barriers include: (a) perceived conflict between work, life, and family plans, (b) gender bias within traditional STEMM careers, and (c) embedded entrepreneurial masculinity within STEMM academic culture. Their reported 'push' entrepreneurial

motivation and perceived structural barriers in traditional STEMM careers are related to the gendered nature of STEMM academia, which will be discussed in the following section.

8.5 Perceived Structural Barriers in STEMM Academia

The qualitative findings indicated perceived structural barriers within STEMM academia, related to the gendered nature of the STEMM academic environment. This includes gender practices, gender bias, discriminated behaviours and embedded stereotypical masculinity within STEMM academic culture. These experiences resonate those of women scientists who experience sex discrimination (Bolzani *et al.*, 2021), gendered practices within STEMM academia associated with masculinity (Orser *et al.*, 2012) such as demands for flexibility/mobility and long work hours (Kuschel *et al.*, 2017). Women scientists face stereotypical challenges as they perceive themselves, and are perceived by others, as unfit and not belonging to the masculinised STEMM culture (Cheryan *et al.*, 2017; Wheadon and Duval-Couetil; 2018). This inflicts significant impact upon women's academic career progression which results in women considering leaving their traditional STEMM careers (Kuschel *et al.*, 2017). Relating to the previous section, the gendered nature of STEMM academia acts as a barrier that 'pushed' some women participants to attend this EEC programme to explore entrepreneurship as a potential alternative career.

First, gender practices within STEMM academic culture imposed difficulty on women participants as they perceived limitations, constraints, and disadvantages in their current and prospect traditional STEMM careers. These gender practices include high demands for flexibility/mobility, long work hours and temporary work nature of STEMM academic careers, as Christina highlighted, "*Every year or every two years I have to move somewhere else,"* and Tina commented, "*I'm doing my lab work that requires me to be in often at weekends."* Mary raised her concern, *"How can you organise your life if you have a six-month contract?"* These gender practices raised concerns, of over two-thirds of interviewees, around conflicts between their childcare/eldercare

responsibilities and family relocation, as Susan commented, *"That's quite hard that you will take the leave for the whole year,"* and Christina added, "*When my parents are more elderly and maybe I have to take on some caring responsibilities for them, then how is that going to work?"* As a result, some women participants intended to seek independence and flexibility through entrepreneurship, as Danna commented, *"I must be flexible all the time when I have children,"* and Ashley said, "*If I could start up a business, I can work from home."* An entrepreneurial career is seen as a "Plan B" for young STEMM women academic researchers who perceive the conflict between childcare and work as a barrier to their STEMM career progression (Treanor, 2019). It is widely acknowledged that women may consider an entrepreneurial career when they experience institutional, structural barriers in their careers particularly when they experience a 'glass ceiling' or '*maternal wall*' (Thébaud, 2015). They subsequently consider entrepreneurship as a '*Plan B*' or an alternative career for working mothers (Thébaud, 2015).

Second, gender bias – including implicit cognitive bias and explicit discriminated behaviours – acts as structural barriers for STEMM women from advancing in their careers (Cadaret *et al.*, 2017; Treanor and Marlow, 2021). This is related to the male-dominated environment and the dominant masculine culture within STEMM academia. Most interviewees noticed the remarkably lower proportion of STEMM women in leadership positions, as Alexia put, *"All the PIs [principal investigators] in plant science are male,"* and Melody highlighted, "*As you go higher, the number of females drop*." The male-dominated environment had cultivated some forms of dominant masculine culture, such as male-only networks, as Tina commented, "*It's usually always like groups of men getting really drunk with this professor,"* and Lisa highlighted, *"If you're going to get a connection or something, you're most likely to have it if you have a friend in there."* The male-dominated environment coupled with the dominant culture of male-only networks reduce a sense of belonging and, subsequently, make it more difficult for women scientists to develop mixed-sex professional networks (Cheryan *et al.*, 2017).

The underrepresentation of STEMM women in leadership positions and masculine-dominated culture within STEMM academia produced a gendered effect upon some women participants. In other words, they perceived gender bias in hiring, getting promotion and funding based on the assumptions that men are more preferable and capable, as Danna highlighted, *"If it's a job application, people tend to lean towards men,"* and Daisy commented, "*For a higher position, maybe it's when they [men] might believe that they are better than you" (Daisy)*. Ashley shared her concern regarding gender bias in funding: *"Funding, they will discriminate women because I saw not many women principal investigators."* The gender bias issues these women participants faced resonate with those of women entrepreneurs who face the stereotypical belief of lacking commercialisation skills (Malmström *et al.*, 2017), resulting in their perceived greater difficulties in hiring (Wolff *et al.*, 2020) and accessing finance (British Business Bank, 2019). Some women participants associated gender bias in hiring with the stereotypes that associate them with maternal role and childcare responsibility, as Mary commented, "*Having children … people assume that you do want them,"* and Stella highlighted, *"They might think 'Oh, she's 25-26 years old, she will probably want to have kids'"* (Stella). STEMM women face gender bias by employers associating women with primary childcarers making them less preferable for hiring (Bolzani *et al.*, 2021).

Finally, there is an association between STEMM academic culture and the stereotypical entrepreneurial masculinity (Bolzani *et al.*, 2021; Cheryan *et al.*, 2017), such as 'confident' and 'detached', as Mary pointed out, *"Guys often have an easier time giving out this perception that they're really good, really confident and really amazing."* Tina mentioned of her supervisor's 'detached' working style which seems to be passed down by his supervisor, "*My supervisor who doesn't give out praise very easily … He had, like, a really tough supervisor. People would come out of meetings crying."* The nature of their men supervisors and colleagues reflects some dominant traits and characteristics associated with the masculine stereotypes of a typical entrepreneur, including 'confident' and 'detached' (Ahl, 2004). This association reinforces the stereotypical beliefs

within the STEMM fields that the typical masculine characteristics in men are preferable, and as a result, women scientists perceived a reduced sense of belonging and felt less fit for the masculinised STEMM culture (Cheryan *et al.*, 2017).

Relating to the SCCT framework, this thesis demonstrates that perceived structural barriers serve as a deterrent to STEMM career interest, progression and retention of STEMM women ECRs (Kuschel *et al.*, 2020). The gendered nature of STEMM academia, which influenced gender practices, gender bias and embedded stereotypical masculinity within STEMM academic culture, was found to demotivate STEMM women ECRs from advancing in their careers. In some cases, they subsequently developed an interest in entrepreneurship as an alternative career for flexibility and independence. The social construction of STEMM academia is largely associated with masculine gender bias and a stereotypical masculinised image of an entrepreneur, perceived by women participants prior to EEC attendance. The following section will discuss further these gendered assumptions within STEMM entrepreneurship perceived by women participants prior to EEC participation.

8.6 Gender Construction of STEMM Entrepreneurship

The qualitative findings outlined the gender construction women participants had in regard to STEMM entrepreneurship, which is largely associated with stereotypical entrepreneurial masculinity. According to one-third of interviewees, the image of a successful entrepreneur is largely associated with a traditional businessman or a wealthy, white, middle-aged man (Jernberg *et al.*, 2020) who has stereotypical masculine traits and characteristics, including self-confidence (Bolzani *et al.*, 2021), forceful and assertive (Ahl, 2004). Some interviewees associated a successful entrepreneur with *"a person in suit"* (Molly), as well as *"middle-aged white men"* who *"go on holiday all the time"* (Celene) and "*have to be a bit ruthless and have recklessness"* (Christina). This stereotypical image is influenced by mainstream blockbuster movies and TV programmes such as *"The Wolf of Wall Street"* and *"The Dragons' Den"* which

are *"very glamourised and dramatic"* (Christina). In some cases, their experience of perceiving themselves unfit for the stereotypical STEMM fields influenced their perceived unfitness for entrepreneurship, as Celene highlighted, "*I'm not the stereotypical proper scientists. That would translate to business as well*."

The entrepreneurial image STEMM women ECRs perceived prior to EEC attendance echoes the stereotypical masculinised image of a prototypical entrepreneur as being self-confident (Bolzani *et al.*, 2021), aggressive, assertive, forceful and dominant (Ahl 2004; Treanor and Marlow 2021). Contemporary media still largely associates a successful male entrepreneur with '*driven personality, a high-status leisure activity, a supportive but invisible family, a focus on financial measures and a global outlook*' (Jernberg *et al.*, 2020). These perceived masculine gender stereotypes potentially decrease women's own perceived ability to pursue entrepreneurial activities, particularly within the STEMM sectors (Hardin and Longhurst, 2016; Wieland *et al.*, 2019). The next section will discuss how the EEC programme influenced women participants' perceived EI and ESE, in relation to extant literature.

8.7 The Assumed Benefits of the EEC

This thesis has related the persisting underrepresentation of women within STEMM and academic entrepreneurship to feminist critiques regarding the gendered nature of entrepreneurship and its education as well as the assumed benefits of EE in effectively enhancing ESE and EI of women participants (Foss *et al.*, 2018). Within the literature review (Chapter 2, Section 2.4.2), it was argued that EEC programmes may potentially alienate some women participants or reduce their perceived ESE as the winners are modelled on the typical male stereotypes of entrepreneurs (Jones, 2014; Jones and Warhuus, 2018). The negative impact of EE upon ESE of women participants was assumed to be mediated by gender barriers (Shinnar *et al.*, 2012; Wieland *et al.*, 2019), which are asserted to have a crucial role in diminishing intentions of STEMM women to pursue STEMM careers (Cadaret *et al.*, 2017). Accordingly, it was predicted that the EEC programme may lead to unexpected gendered outcomes in relation

to their perceived gender barriers to entrepreneurship, ESE and EI, which potentially perpetuate greater disadvantage for women participants who do not fit with the entrepreneurial masculinity (Jones and Warhuus, 2018).

8.7.1 The EEC Impact upon Entrepreneurial Intentions

The quantitative findings demonstrated that women participants perceived significantly higher EI following the competition, while men participants did not demonstrate any change in this regard. In addition, there was no significant sex-based difference in EI following the competition. This contrasts with Jones and Waarhuus' (2018) contention that women may be deleteriously affected by gender barriers and would not have a similar uplift in EI following the competition. The results are aligned with previous research that claimed that women tend to benefit more from EE than their male counterparts as they demonstrated a significantly higher change in their perceived EI following EE attendance (Nowiński *et al.*, 2019; Wilson *et al.*, 2007).

However, women participants did not demonstrate lower EI than their male counterparts before and after EEC participation, contrasting with the previous research highlighting lower EI among women despite EE attendance (Nowiński *et al.*, 2019; Westhead and Solesvik, 2016). A reason behind this particular EI uplift among women participants is prior entrepreneurial motivation. The quantitative findings herein suggested that women participants with prior motivation to start a business demonstrated significantly higher EI following EEC attendance, indicating that the programme is particularly effective in enhancing EI of women participants who had prior entrepreneurial motivation. Relating to the SCCT framework, prior entrepreneurial motivation had an important role in influencing EI of women participants before and after EEC attendance. The findings provided a reason for the particular EI uplift among women after EE attendance (Nowiński *et al.*, 2019; Wilson *et al.*, 2007), which is likely to be influenced by self-selection bias of women participants, with prior entrepreneurial motivation, selecting themselves into EE programmes (Bae *et al.*, 2014; Liñán *et al.*, 2018).

8.7.2 The EEC Impact upon Entrepreneurial Self-Efficacy

The EEC programme significantly increased ESE of women participants in all aspects and eliminated sex-based differences in perceived ESE in finance and cost estimation. This supports previous studies indicating that EEC participation enhances entrepreneurial knowledge and skills (Mosey *et al.*, 2012; Pocek *et al.*, 2022; Watson *et al.*, 2018), contributing to entrepreneurial competence development for all participants (Treanor *et al.*, 2021). The findings contrast with previous research highlighting negative effects (Arranz *et al.*, 2017; Kassean *et al.*, 2015) or non-significant influence (Vanevenhoven and Liguori, 2013) of experiential EEs upon ESE of students. In addition, there was no sex-based difference in ESE following the competition; contrasting with prior research reporting lower ESE of women when compared to men (Nowiński *et al.*, 2019; Shinnar *et al.*, 2014; Wilson *et al.*, 2007).

However, the qualitative findings, reported in Section 8.5, pointed towards structural issues, related to women participants' perceiving gender bias within STEMM academia, based on the gender assumptions that men are more capable and preferable than women. In some cases, this assumption was translated into their perceived unfitness for entrepreneurship. This is supported by the quantitative findings, which highlighted that the increase in ESE of women participants was significantly influenced by the lower perceived barriers in stereotype threat and identifying stakeholders. These findings support previous feminist studies regarding the gender bias that women entrepreneurs face, particularly the stereotypical belief that they lack commercialisation skills (Malmström *et al.*, 2017). Reflecting through the SCCT framework, these findings indicate the influence of socio-cognitive factors, particularly perceived structural barriers, upon women's perceived knowledge and skills in commercialisation (Kuschel *et al.*, 2020; Wieland *et al.*, 2019). The next section will discuss the EEC impact upon key gender aspects of perceived gender barriers to entrepreneurship.

8.8 Gendered Outcomes of the EEC

The quantitative findings outlined that the EEC influenced the majority of perceived gender barriers to entrepreneurship of both sexes. However, there are five out of eleven gender barriers to entrepreneurship upon which the programme had particular impact among women participants. These barriers include perceived stereotype threat, sex discrimination, lack of role models and mentors, networking difficulty and childcare-work conflict. The competition had a positive impact upon most of these barriers; however, women participants still perceived significantly higher barriers in sex discrimination and childcare-work conflict than their male counterparts. They also perceived a significantly higher barrier in the lack of role models and mentors after attending the competition. Consequently, these barriers have been highlighted as gender implications, which have arisen from the quantitative study, which were subsequently explored through the semi-structured interviews of 45 women participants. Accordingly, the following sections will discuss the gender influence of the EEC programme upon key perceived gender barriers to entrepreneurship of women EEC participants.

8.8.1 The EEC Impact upon Perceived Stereotype Threat and Sex Discrimination

Although the quantitative findings asserted the positive EEC impact upon perceived stereotype threat and sex discrimination, the qualitative findings revealed additional different experiences. First, the EEC programme significantly reduced these perceived barriers for both sexes, but particularly for women participants. As a result, there was no sex-based difference in perceived stereotype threat following the competition. This could be explained by the qualitative findings, which revealed that the EEC programme, through a predominantly female environment and use of role models in delivery, helped a quarter of interviewees overcome the potential deterrent of the prototypical male entrepreneur/innovator and evaluate their entrepreneurial potential realistically. The qualitative findings (see Section 7.2.1) herein outlined that the

competition was found to provide a sex-balanced and less-threatening environment for women participants. As Emily highlighted, "*Almost all teams had women as CEOs," and Christina added, "There was a lot of other women."* This positively influenced their perceived sex discrimination as they felt that they were competing on a fair ground, as Christina put: "*It made me feel like we all just competed on the same position."*

The findings support Neumeyer's (2020) suggestion that a sex-balanced environment plays an important role in enhancing STEMM women's likelihood to engage in entrepreneurial activities as they find the environment less threatening. The findings contribute to the EE literature that an EE programme can potentially play an important role in reducing perceived sex discrimination in entrepreneurship (Elliott *et al.*, 2020) through providing an equal proportion of men and women participants, guest speakers, and other stakeholders within the EE environment (Neumeyer, 2020).

Through meeting diverse entrepreneurs, the participants gained a more realistic construction of a typical entrepreneur, and the competition demystified the concept of entrepreneurship, providing a sensible account of the realities of starting and running an enterprise in line with Welter's (2017) 'everyday entrepreneurship'. According to the qualitative findings, this can be attributed to women participants' exposure to entrepreneurs with diverse profiles, in terms of age, sex and characteristics. As Blanca mentioned of a young entrepreneur, "*He was 18 years old, but he was an entrepreneur,"* and Rosa mentioned of a non-typical women entrepreneur, *"You don't really expect a businessperson to have pink hair."* These experiences added diverse perceptions of an entrepreneur among women participants, with Rosa highlighting, "*Now, I think anyone could do it,"* while Blanca commented, *"Maybe that age thing doesn't matter as long as you are really passionate about your business idea."*

However, for some women participants, the competition reinforced the stereotypical masculinised image of an entrepreneur which was reproduced by entrepreneur speakers and competition participants. They reinforced traits and

characteristics of the stereotypical entrepreneur such as being financially driven (Jernberg *et al.*, 2020), confident and charismatic (Jones and Warhuus, 2018), as Nicole mentioned, "*I would see them as just looking for profit, but not necessarily looking to actually solve an actual problem*," and Mary highlighted, *"You need to have a magnetic personality and be really good at bull**ting."* Alexia mentioned of some men competition participants, "*I didn't like when they pitched actually because they were too confident for their abilities."* These reasons explain the quantitative findings regarding why women participants still perceived a significantly higher barrier in sex discrimination than their male counterparts following the competition.

Finally, some women entrepreneurs within the EEC programme reinforced negative stereotypes towards STEMM women entrepreneurs as being defensive, superficial and lacking in management skills, as highlighted by Alexia who said, "*I didn't like the way [a woman entrepreneur] said that they haven't found a way to actually work with people,"* while Lucia commented, *"She made it sound easy… but, in my opinion, it's like their companies are the exception and not really very realistic."* Cindy mentioned of a women entrepreneur that, *"Her answer was really defensive and her language was quite combative."* This supports previous literature suggesting that some women entrepreneurs align themselves with the image of an agentic entrepreneur (Eagly and Johannesen-Schmidt, 2001) and/or portraying themselves as an 'entrepreneur superwoman' (Byrne *et al.*, 2019; Lewis, 2014). They perpetuated the traditional entrepreneurial stereotypes and, as a result, highlighted that STEMM women entrepreneurs are in a disadvantaged position (Byrne *et al.*, 2019).

8.8.2 The EEC Impact upon Perceived Lack of Role Models and Mentors

While the quantitative findings asserted negative EEC impact upon perceived lack of role models and mentors among women participants, the qualitative findings revealed additional different experiences. First, the quantitative findings revealed that the EEC programme had negative impact upon perceived lack of role models and mentors among women participants, while this is not

the case for their male counterparts. This can be explained by the qualitative findings which highlighted that some women participants reflected on the underrepresentation of STEMM women entrepreneurs as they observed the lower proportion of women speakers, mentors and competition judges. Whitney highlighted, *"The judges, except the one lady, are all men. As you go higher up, they are all men,"* and Crystal added, *"A lot of the mentors are male. I realise actually, in the business, there is a lot more male than female."* The findings support the feminist critiques regarding the limited effect of women role models upon career intentions of STEMM women as they may instead raise awareness of the underrepresentation of women scientists (Breda *et al.*, 2018; Byrne *et al.*, 2019).

Second, despite the negative effects of women entrepreneurial role models, some women participants were particularly inspired by women entrepreneurs for their entrepreneurial and career progression, through: (a) relating their academic experience to commercialisation opportunities, (b) introducing alternative career paths in STEMM as well as (c) enhancing self-confidence in starting a business. Melody highlighted, "*She talked about transferring from academia to industry, and that was brilliant,"* and Ruth mentioned of a women speaker, *"The finance woman who had the good job title of 'entrepreneur in residence'. She sounded like she had a really good career journey."* Lisa commented, "*It feels like it's not going to be like science. In business, it feels like it's much easier for some reason."* These findings support previous literature regarding the positive impact of women entrepreneurial role models on women's decision to pursue a non-traditional career through influencing their entrepreneurial attitude, capabilities, and interest (Austin and Nauta, 2016).

In addition, the qualitative findings outlined that inspiring, non-stereotypical male entrepreneurial role models can generate just as positive effects upon entrepreneurial and career aspiration for some women participants, as Cindy highlighted, "*I really like [a male entrepreneur speaker]. You could tell he had integrity… He didn't seem to have a huge ego,"* and Emily mentioned of a young male entrepreneur, *"He's extremely young and he just finished his MSc but he*

thought of an idea and then he put it into practice. That's actually inspirational." Supported by prior literature, regardless of being men or women, inspiring role models are found to influence entrepreneurial interest of women university students (Nowiński and Haddoud, 2019). In some cases, women are more likely to admire male role models as they may share similar traits and characteristics (Wohlford *et al.*, 2004). The findings contribute to the feminist and EE literature by highlighting a potential substitute for the lack of women entrepreneurial role models, in enhancing STEMM women's entrepreneurial career aspiration.

8.8.3 The EEC Impact upon Perceived Childcare-Work Conflict

While the quantitative findings posited positive EEC impact upon perceived childcare-work conflict among women participants, the qualitative findings revealed additional different experiences. First, the EEC programme significantly reduced participants' perceived barrier in childcare-work conflict, particularly for married women participants. This can be explained by the qualitative findings which highlighted that some women participants latterly perceived entrepreneurship as a more flexible career. For example, Tina latterly perceived entrepreneurship as a short-term project rather than a long-term commitment as the competition provided understanding regarding the expected return on entrepreneurial investment of academic spinouts, "*Something I hadn't realised before the competition was how quickly businesses can turn over. You can exit the business within five years."* This finding adds to the entrepreneurship literature that an EEC programme can reduce perceived conflict between childcare and work life of STEMM women by providing an alternative perception of entrepreneurship as a flexible, short-term career. In addition, within the entrepreneurship literature, childcare and work issues are widely associated with necessity women entrepreneurs (Byrne *et al.*, 2019) running a home-based and/or part-time business (Thébaud, 2015). This finding adds to this conversation by dissociating perceived childcare-work conflict from home-based, low-growth entrepreneurial activities and highlighting the potential influence of the EEC programme in addressing perceived childcare-work conflict

for STEMM women who seek to engage in a STEMM-related entrepreneurial activity.

Second, despite the positive EEC impact upon perceived childcare-work conflict, women participants still perceived significantly higher childcare-work conflict than their male counterparts, with the difference being greater following the competition. Supported by the qualitative findings, over one-third of interviewees largely associated entrepreneurship with a high level of commitment and long working hours. In addition, five women participants perceived entrepreneurship as a risky career. Mila highlighted, *"It's the demands of being an entrepreneur. I think it'll definitely affect your family life. When you see all the case studies, they really devote their whole time,"* and Ruth commented, *"We had the talk from the guy who had the graph of the ups and downs. When you've got a family, you've got to consider that."* The findings support previous EE research that some EE programmes are found to increase perceived risk of students towards entrepreneurship (Efrata *et al.*, 2021; Westhead and Solesvik, 2016) and may encourage students who perceived higher risk to become more realistic regarding an entrepreneurial career (Oosterbeek *et al.*, 2010).

Finally, for some women participants, the underrepresentation of STEMM women entrepreneurs as well as the overlooked issue around childcare-work life of an entrepreneur during the competition reinforced their assumptions that STEMM women entrepreneurs with childcare responsibilities are in disadvantaged position or discriminated against, as Nicole shared: *"It wasn't really mentioned or talked about… I just assumed there would be an issue with that,"* and Daisy highlighted, *"Everybody who came to talk… were all men… It's tricky for a woman if you have kids."* These findings contribute to the EE literature regarding gendered EE impact upon women participants, in increasing their perceived conflict between childcare and work in entrepreneurship for those who plan to have children in the future. Consistent with prior literature, STEMM women ECRs face multiple gender barriers within STEMM academia and entrepreneurship. They bare a societal pressure to undertake a disproportionate

share of domestic and childcare responsibility (Hughes *et al.*, 2017; Marlow and McAdam, 2012) while perceiving the STEMM academia and entrepreneurship as time-demanding and requiring a high level of commitment (Hughes *et al.*, 2017).

8.9 Perceived Gender Barriers to STEMM Entrepreneurship and Non-STEMM Entrepreneurial Intentions

In relation to entrepreneurial interest, the qualitative findings revealed that over one-third of the interviewees were interested in pursuing a non-STEMM-related business, particularly a small lifestyle business or a social enterprise, as Tiffany highlighted, *"I always wanted to start a food truck or something small,"* and Danna commented, *"I would like an easier business with smaller branches."* They perceived several barriers to traditional, high-growth STEMM entrepreneurship, including: (a) the lack of their competitiveness in the respective market, (b) the lack of suitable business opportunities, (c) the financial pressure in its nature, (d) the complication of the business process and (e) the need to be flexible for a future family plan. Some example quotes include, *"It's a big responsibility"* (Cindy), *"I don't feel knowledgeable enough*" (Rosa), *"I don't feel like there is an opportunity to develop a business"* (Lucia), and *"I have to be flexible all the time when I have children"* (Danna).

Women scientists and women entrepreneurs tend to report a different start-up motivation and approach to entrepreneurship (Kuschel *et al.*, 2017) towards a small enterprise for personal profit and value with more sensitivity to loss and risk (Marlow and Swail, 2014). This can be partly attributed to the masculine gender bias embedded within entrepreneurship (Jones and Waarhuus, 2018), which subsequently influenced women's perceived lack of confidence in commercialisation. This supports the quantitative findings which highlighted that the competition deterred self-confidence in ESE of women participants who perceived a high barrier in stereotype threat following the competition. Consequently, women scientists tend to feel less competent in their ability to recognise technology business opportunity, which is found to be a critical factor influencing EI of STEMM men and women (Armuña *et al.*, 2020; Neill *et al.*,

2015). Considering that women tend to report lower self-efficacy in the domains that are incongruent to their biological sex, it is likely that women scientists are less likely to recognise a STEMM business opportunity and, subsequently, less likely to develop intentions to start a business in such field (Wieland *et al.*, 2019). As a result, STEMM women tend to perceive themselves as not suitable to run a high-growth venture (Gupta *et al.*, 2019). The findings argue for the assumptions regarding women's lack of confidence in commercialisation due to their deficiency by highlighting the perceived masculine construction of an entrepreneur that negatively influences women participants' own perceived confidence in commercialisation (Hardin and Longhurst, 2016; Wieland *et al.*, 2019).

In addition, some women participants who had future child plans reported similar reasons to STEMM women who have taken career breaks (Sharma, 2022). They perceived themselves as a primary child carer, expected by society to conform to social mothering expectations (Marlow and Swail, 2014). Consequently, they seek autonomy and independence from entrepreneurship as they perceive structural constraints within their traditional STEMM careers after taking maternity leave (Sharma, 2022). As a result, they are more likely to engage in a small enterprise for personal profit, value (Marlow and Swail, 2014) and childcare flexibility (Thébaud, 2015).

Reflecting through SCCT, despite the quantitative results outlining that the EI of women participants was not influenced by their perceived ESE, these findings indicated conflicting results. The qualitative findings suggested that, in some cases, interviewees' perceived lack of competitiveness and skills in commercialisation was found to demotivate them from pursuing a traditional STEMM entrepreneurial activity. Considering that starting a non-STEMM related, home-based lifestyle business involves a simpler business model and strategy, this may explain the non-significant relationships between perceived ESE and EI of STEMM women ECRs in this thesis. However, studies that provide categorisation of industries/sectors in relation to EI in general remain scarce. These findings add to the EI literature regarding the necessity to control for

industries/sectors of business that STEMM women would like to pursue when considering a career path in entrepreneurship (Kuschel *et al.*, 2017; Marlow and Swail, 2014).

8.10 Summary

This chapter has analysed the quantitative and qualitative findings on the EEC impact upon perceived gender barriers to entrepreneurship, ESE and EI of women STEMM ECRs, and it has related their significance to the existing literature. The critical realist approach facilitates the identification of plausible explanations and causal mechanisms between the quantitative and qualitative findings to provide suggestive/indicative but fallible EEC gendered outcomes upon STEMM women ECRs. As a result, this thesis provides novel insights into the differential EEC impact between men and women participants (quantitative study), the differences among women participants (qualitative study) as well as potential reasons behind the alignments and conflicts between the quantitative and qualitative findings (qualitative study). In essence, this thesis provides plausible explanations for this EEC cohort that may resonate with STEMM women undertaking similar EEC programmes with similar cohort characteristics.

The EEC programme was found to generate an overall positive impact upon men and women participants, particularly in enhancing their ESE and EI as well as reducing several perceived gender barriers to entrepreneurship. However, the qualitative findings explored variation around the average effect to reveal that the EEC programme produced unintended gendered outcomes for some women. For instance, some women reported that the EEC perpetuated the stereotypical masculine stereotypes of an entrepreneur, reinforcing perceived conflict between childcare and the work-life of a woman entrepreneur as well as highlighting a negative image of STEMM women entrepreneurs.

The discussion from the quantitative and qualitative findings contributes to extant literature in EE, EI and gender, as follows:

- The employed critical realist stance underlying a mixed-methods (QUAN → Qual) approach allowed this thesis to produce in-depth insights regarding: (a) the particularly positive EEC impact upon EI of women participants as a result of their self-selection bias, and (b) the heterogeneous EEC impact upon their perceived gender barriers to entrepreneurship.
- The findings provided novel insights into the unintended gendered outcomes of the EEC programme which unconsciously reproduced gendered outcomes for women participants in: (a) perpetuating the stereotypical masculine stereotypes of an entrepreneur, (b) reinforcing perceived conflict between childcare and the work-life of a woman entrepreneur as well as (c) highlighting a negative image of STEMM women entrepreneurs.
- The findings contribute to the theoretical development of EI by expanding the scope of intention-based analysis beyond traditional gender-neutral measures towards an inclusive measure, through analysis revealing perceived structural barriers as critical factors influencing EI.

The next chapter will provide the conclusion of this thesis, its theoretical and empirical contributions as well as its limitations and practical implications for researchers, practitioners and policy makers.

9. Conclusion

This thesis presented quantitative and qualitative findings, relating to the influence of an enterprise education competition (EEC) on the entrepreneurial intentions (EI) and self-efficacy (ESE) of STEMM ECRs, to address the overarching research question: "*To what extent does the enterprise education competition (EEC) as a vehicle of entrepreneurial education (EE) influence perceived gender barriers to entrepreneurship, entrepreneurial self-efficacy (ESE) and in turn entrepreneurial intentions (EI) of STEMM women early career researchers (ECRs)?"*

Informed by a critical realist stance, a mixed-methods approach was employed comprising of pre- and post-surveys of 120 EEC participants, followed by 45 semi-structured interviews of women participants. Social Cognitive Career Theory (SCCT) was proposed as a suitable theoretical framework that captures socio-cognitive factors (perceived gender barriers to entrepreneurship), individual cognitive variables (perceived ESE and EI), as well as individual predisposition (prior entrepreneurial exposure and motivation). The EEC programme was found to generate a positive impact upon perceived ESE and EI for all participants. However, it was also found to reproduce unintended gendered outcomes in relation to perceived gender barriers to entrepreneurship. This thesis provides significant theoretical and empirical contributions to the literature in EE, EI and gender. This chapter begins by outlining the theoretical and empirical contributions of the thesis followed by discussing its limitations, implications and recommendations for EE educators, researchers and policymakers. The recommendations for future research are outlined at the end of the chapter.

9.1 Theoretical Contributions

This thesis contributes to the theories in EE, EI and gender in two major ways. First, it provides novel insights into the unintended gendered outcomes of the EEC programme, in response to feminist critiques regarding the assumed

benefits of EE programmes in enhancing ESE and EI of women (Foss *et al.*, 2018). It is acknowledged that the masculine gender construction within entrepreneurship has been unconsciously reproduced by entrepreneurship educators (Jones, 2014; Jones and Warhuus, 2018). However, there is limited understanding of the gendered process and outcomes of EE programmes and how they affect women's entrepreneurial interest and proclivities (Hughes *et al.*, 2017; Wheadon and Duval-Couetil, 2018). The thesis provides theoretical understanding into this inquiry that the EEC programme indeed unconsciously reproduced gendered outcomes for women participants in: (a) perpetuating the stereotypical masculine stereotypes of an entrepreneur, (b) reinforcing perceived conflict between childcare and the work-life of a woman entrepreneur as well as (c) highlighting a negative image of STEMM women entrepreneurs. These findings lend support to the contention that structural issues, rather than essentialist deficiencies among women, underpin their differential participation rates in STEMM innovation within academic and industry employment environments, with consequential effects for women's STEMM self-employment (Kuschel *et al.*, 2020; Neumeyer, 2020).

Second, the thesis contributes to the development of Social Cognitive Career Theory (SCCT) by capturing a socio-economic aspect of perceived gender barriers to entrepreneurship as well as individual predisposition. The SCCT was employed and developed in response to calls for theoretical models that provide critical and more complex analysis on factors influencing EI, particularly of STEMM women (Donaldson, 2019; Liguori *et al.*, 2018; Pfeifer *et al.*, 2016). Within this thesis, the SCCT model incorporates eleven perceived gender barriers to entrepreneurship as well as three aspects of individual predispositions – including prior entrepreneurial motivation, family business background and prior entrepreneurial exposure. Among all tested perceived barriers, the quantitative analysis identified five gender barriers to entrepreneurship of STEMM women ECRs, including perceived stereotype threat, sex discrimination, childcare-work conflict, lack of role models and mentors, as well as networking difficulty. Supported by the qualitative study, the

EEC programme was found to reproduce gendered outcomes for women participants in relation to perceived entrepreneurial stereotypes, availability and influence of entrepreneurial role models, as well as childcare and work issues in entrepreneurship. These findings contribute to the theoretical development of EI through analysis revealing perceived structural barriers as critical factors influencing EI (Laguía *et al.*, 2022).

9.2 Empirical Contributions

This thesis employed a critical realist (CR) stance underlying a mixed-methods approach, namely explanatory research design (QUAN → Qual) to explore the influence of the EEC programme upon STEMM women ECRs in relation to their perceived gender barriers, ESE and EI. This is apposite for this study as it recognises the reality of quantifiable outcomes and impacts of EE interventions upon participating individuals, while also acknowledging that the social world, and constructs such as gender, are socially constructed and therefore more appropriately explored using qualitative methods. The CR approach bridges the gap between current ontological debates (Mingers, 2004) between *interpretivism* and *positivism* regarding their incommensurability and incompatibility (Howe, 1988; Smith and Heshusius, 1986). In other words, it allows a certain degree of inference between the quantitative and qualitative findings (Zachariadis *et al.*, 2013) where the statistical analysis identifies causal relationships between the studied factors, and the qualitative analysis identifies structural processes of the studied phenomenon.

The thesis addresses the knowledge gap in EE and gender research, where the former is dominated by the positivist approach and the latter by the interpretivist approach. The overreliance upon the two traditional approaches has limited our understanding of EE and gender phenomena. This thesis addresses these gaps as it provides plausible explanation to the statistically-supported particular uplift of ESE and EI among women participants as a result of their prior entrepreneurial motivation; responding to the feminist critiques regarding the assumed benefits of EE upon women. It also reveals that the EEC

had a heterogenous impact on perceived gender barriers among women participants; these findings could not be captured by solely employing the quantitative study. As a result, despite the acknowledged limitations regarding small sample size, the thesis is able to produce in-depth insights regarding the EEC impact upon women (Jones and Warhuus, 2018) as it answers not only "What works for all participants?" and "What works and does not work for women participants?" but also "Why?" (Brentnall *et al.*, 2018b). This contributes to calls for research that explore causal mechanisms at all levels of reality and the relationships between them to create effective change through feminist research (New, 2020).

9.3 Implications for Entrepreneurship Educators and Policymakers

The insights from this mixed-methods study can inform future delivery of the EEC programme but also may be useful for other EE programmes/competitions seeking to adopt a gender-inclusive approach and minimise perceived structural barriers for women participants. The thesis also informs the design of future policy to promote STEMM women's engagement in academic entrepreneurship and commercialisation activity. First, although this EEC programme was not specifically designed to reduce perceived structural barriers, it is worth noting the positive impact it had in reducing perceived barriers in stereotype threat and childcare-work conflict. It is also evident that the reduced perceived stereotype threat subsequently enhanced perceived ESE and EI of STEMM women ECRs. These findings highlight the necessity to consider perceived structural barriers as key impact measures of EEC/EE programmes.

Second, despite the EEC programme being associated with reducing perceived barriers in stereotype threat and childcare-work conflict, analysis of interviews revealed some negative aspects. Intentions to start a business may not be translated into an entrepreneurial activity among women participants as, for some of them, the competition was still found to: (a) reproduce the stereotypical masculinised entrepreneurial image, (b) reinforce negative stereotypes towards STEMM women entrepreneurs, (c) raise awareness of sex-imbalance within

STEMM entrepreneurship and (d) increase perceived conflict between future childcare and work-life of an entrepreneur. This highlights the limited effect of a generic EEC programme in enhancing ESE and EI of STEMM women ECRs and points towards the importance of designing and delivering gender-sensitive EEC/EE programmes to reduce their perceived structural barriers and enhance their perceived ESE and EI.

In addition, it was found that over one-third of women participants referred their entrepreneurial interest to a non-STEMM-related business. This could detract the effectiveness of the EEC programme in enhancing ESE and EI related to STEMM entrepreneurship and commercialisation activity among women as they still perceived several barriers to STEMM entrepreneurship, including: (a) the lack of their competitiveness in the respective market, (b) the lack of suitable business opportunities, (c) the financial pressure in its nature, (d) the complication of the business process and (e) the need to be flexible for a future family plan. This suggests that promoting STEMM women entrepreneurship through EE/EEC programmes alone is insufficient as it requires integrated policy support to reduce their perceived difficulties in starting and running STEMM entrepreneurial, academic and commercialisation activities.

In summary, to effectively enhance STEMM women entrepreneurship through EEC interventions, entrepreneurship educators and policymakers are strongly encouraged to:

- Incorporate an aim to address perceived structural issues when designing EEC interventions and/or EE policy. For example, reducing negative gender stereotypes in entrepreneurship and/or addressing issues around perceived conflict between childcare and work life of an entrepreneur.
- Promoting a high women participation rate in EE/EECs and ensuring diverse profiles of entrepreneurial guest speakers/mentors/judges in terms of sex, age and characteristics.

- Design support policy/scheme offering specific funding, mentoring and childcare support for STEMM women who intend to engage with STEMM entrepreneurial, academic and commercialisation activities.

9.4 Limitations

The key limitations of the thesis include: (a) the lack of a counterfactual group, (b) the generalisability and transferability of qualitative data, (c) plausible interviewee bias and (d) the small sample size of the quantitative study. First, the study did not construct a counterfactual group of STEMM women and men ECRs who did not participate in the EEC programme. While the use of a counterfactual group is sometimes used by EE scholars in evaluation research (Nabi *et al.*, 2017; Rauch and Hulsink, 2015), it is common that a counterfactual group is not constructed due to the practical impossibility of obtaining such a suitable control group (Fayolle and Gailly, 2015; Piperopoulos and Dimov, 2015). In addition, constructing the counterfactual is problematic because participants self-select into the programme and are not randomly selected from the population (Bae *et al.*, 2014; Liñán *et al.*, 2018). Factors affecting self-selection to an EEC programme include pre-education entrepreneurial intentions, prior entrepreneurial exposure, and entrepreneurial motivation (Fayolle and Gailly, 2015; Liñán *et al.*, 2018). This thesis compared men and women participants that self-selected to the YES EEC programme. Therefore, the men acted as the control group for women.

Second, generalisability and transferability is a common limitation raised from qualitative research interviews. It is acknowledged that the qualitative interview dataset is contextually situated and may not be applicable to other settings (Haraway, 1988). It is also acknowledged that the generalisability and transferability is not a purpose of employing the semi-structured interviews in this research. The aim of the semi-structured interviews is to: (a) understand the underlying process of how the EEC programme influenced perceived barriers, ESE and EI of STEMM women ECRs, how they made sense of these aspects as

well as (b) to ascertain whether there are gendered reasons underlying the patterns or differences that arose from the quantitative analysis.

Third, the interview participants might associate the researcher with the organiser of the EEC programme. This may influence interviewee bias of the participants providing falsely positive answers because they may expect that their interview might be heard by the organising team (Saunders *et al.*, 2016). The interviewees may also choose not to reveal or discuss some aspects of particular events during the competition. Prior to the semi-structured interviews, the researcher ensured the confidentiality of interview data and the anonymity of interviewees.

Lastly, the sample size of this study is relatively small, especially in relation to number of variables employed in the data analysis. It was initially expected that the researcher would collect the data from YES 2019 and 2020 cohorts. Due to the pandemic, it was only possible to collect the data from the cohort in 2019. A total of 120 complete surveys were received; accounted for 87% response rate. This number is considered appropriate when compared to EE evaluation research which usually involve similar numbers of sample size (Cadenas *et al.*, 2020; Rauch and Hulsink, 2015).

9.5 Recommendations for Future Research

First, the findings from this study highlight the necessity for EE scholars to look beyond the dominant EE measures such as EI and ESE to also include structural gender barriers to entrepreneurship when examining EE impact (Jones and Warhuus, 2018; Laguía *et al.*, 2022); responding to concerns emanating from gender and EE literature (Foss *et al.*, 2018; Jones and Warhuus, 2018) and discussions around gendered learning experience (Kubberød *et al.*, 2021). A number of the survey items measuring gender barriers to entrepreneurship were employed from dated literature (Swanson and Tokar, 1991a, 1991b; Spencer, 1993). Future research could develop a set of measurement for key gender barriers to entrepreneurship – for example, stereotype threat, sex discrimination, childcare-work conflict and the lack of role models and mentors

– similar to research from Mcgee *et al.* (2009) which provides refinement and standardisation of ESE measurement.

Second, there is limited understanding of which particular activities and features within EEC programmes influenced perceived gender barriers among EEC participants. Future research could use quantitative data to compare differences across EE programmes in relation to specific features which increase their gender neutrality, and to identify best practice for reducing structural barriers. Similar to the study of Wegner *et al.* (2019), future research could compare the effectiveness of different EEC programmes across different universities or at national or regional levels. More robust quantitative analysis techniques, such as Structural Equation Modelling, should also be employed. This thesis solely conducted *t-tests*, regression and difference-in-differences analyses due to its limited sample size. In addition, qualitative data could inform our understanding of how such specific features influence participant perceptions. Researchers are encouraged to conduct experiential research, such as ethnography, to enhance reflexivity of EE evaluation research (Alvesson and Sköldberg, 2017).

Third, EE scholars are encouraged to clarify and control for industries/sectors (STEMM or non-STEMM related) when exploring STEMM women's EI. For example, scholars exploring EI and gender have employed social role theory to categorise types of businesses into gender-congruent and gender-incongruent domains (Wieland *et al.*, 2019). By clarifying and controlling for industries/sectors of businesses which determine gender characterisation in entrepreneurship and entrepreneurial intentions, scholars can deepen their understanding of specific gender barriers or drivers to STEMM and/or non-STEMM entrepreneurial intentions of EE participants as well as EE impact upon them.

Fourth, EE scholars are recommended to conduct longitudinal follow-up studies tracking STEMM women's subsequent commercialisation/entrepreneurial activity. Despite EE scholars exploring the intention-behaviour link in student entrepreneurship (Harima *et al.*, 2021; Kautonen *et al.*, 2015), studies that aim

to explore this link among women (Shinnar *et al.*, 2018; Shirokova *et al.*, 2016), particularly within the context of STEMM entrepreneurship, remain scarce.

Fifth, it is noteworthy that the EEC programme affected not only women participants but also their male counterparts. The competition reduced perceived barriers in stereotype threat and childcare-work conflict of both men and women STEMM ECRs, even though its impact was stronger on the women participants. Given the emerging interest in entrepreneurial masculinity and fatherhood (Hytti *et al.*, 2023), the finding from this thesis suggests that the influence of gender and family considerations upon STEMM men in relation to their career decisions is underexplored and worthy of further research. This is consistent with the critiques regarding the dominant focus of gender research upon women, which hinders the opportunity for scholars to generate broader questions and explore the heterogeneity of the gender and entrepreneurship research field (Marlow, 2020; Treanor, 2022).

The existing literature highlights the benefit of entrepreneurial education and training that is tailored for the given sector or context. However, in a quest to ensure that entrepreneurial education and training is inclusive, we must also consider the individual participants and the influence of our choice of words, examples, guest speakers and settings for delivery upon their experiences and outcomes. This thesis makes a small contribution exploring an extra-curricular, short-term competitive EE format but illustrates that much more research is required across the different types (compulsory, credit-bearing, extra-curricular non-credit, short-term, long-term, sector specific, etc.) of EE and training interventions. In this way, we can contribute to more inclusive enterprise ecosystems and equitable societies.

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Appendices

A. Pre-Questionnaire

Pre-Questionnaire

Information for Research Participants

Your participation in this research should be voluntary, and you may change your mind about being involved in the research at any time, and without giving a reason. This research has been reviewed and given favourable opinion by the Nottingham University Business School Research Ethics Committee.

What is the research project called?

The Impact of Entrepreneurship Education Effects upon Entrepreneurial Intentions of STEMM Early Career Researchers

Who is carrying out the research?

Sahattaya Achtzehn, a PhD student in Entrepreneurship and Management at Nottingham University Business School.

What is the research about?

I would like to find out how early career researchers (ECRs) in Science, Technology, Engineering, Mathematics and Medicine (STEMM) develop their attitude towards entrepreneurship as a potential career choice before, during and after attending a business plan competition.

More specifically, I would like to establish how a business plan competition might influence attitudes and intentions towards entrepreneurship as a potential career choice.

What groups of people have been asked to take part, and why?

I am inviting ECRs who attend the Young Entrepreneurs Scheme (YES) Competition 2019 to be involved. The YES Competition is one of the first business plan competitions designed specifically for STEMM ECRs across higher education (HE) institutions in the UK.

What will research participants be asked to do?

You are being asked to complete pre- and post-online questionnaires. You will be asked about your educational background, some personal background information, your motivation for participating in the YES Competition and your attitude towards entrepreneurship as a potential career choice.

What will happen to the information I provide?

The data will be collected and treated confidentially and the name of your institution will not be asked for. Your contact e-mail will be asked in both pre- and post-questionnaires to match the pre- and post-results. You may be contacted by the research for further interview. If you do not want to be contacted by the researcher for further interview in the future, please inform the researcher via sahattaya.achtzehn@nottingham.ac.uk

I am committed to carrying out my research according to The University of Nottingham Code of Research Conduct and Research Ethics (2016) and the ethical guidelines provided by the British Educational Research Association (online at https://www.bera.ac.uk/researchers-resources/publications/ethical-guidelines-for-educational-research-2018). I will also conform to General Data Protection Regulations.

What will be the outputs of the research?

Only my supervisors and I will have access to the raw data. All information collected while carrying out the study will be stored in a password protected folder on a University of Nottingham server. All data will be anonymised and no individual will be identifiable from any published findings.

Primarily, the data will inform my PhD thesis. Additionally, it is intended that my research findings will be disseminated through academic publications such as peer reviewed journal articles, book chapters, conference papers etc.

Consent Form

By completing and submitting this questionnaire you are consenting to the following statements:

- I have read the Participant Information and the nature and purpose of the research project has been explained to me. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I understand that while information gained during the study may be published, I will not be identified and my personal results will remain confidential.
- I understand that data will be stored in a password protected folder on a University of Nottingham server shared by the researcher and supervisors. It will be stored until the book and article are published (minimum of 7 years).
- I understand that I will be provided with a privacy notice under the General Data Protection Regulation (Participants based in EU only).
- I understand that I may contact the researcher if I require further information about the research, and that I may contact the Research Ethics Committee of the School of Business, University of Nottingham, if I wish to make a complaint relating to my involvement in the research.

Contact details

Researcher: Sahattaya Achtzehn (sahattaya.achtzehn@nottingham.ac.uk)
Supervisor: Dr. Lorna Treanor (lorna.treanor@nottingham.ac.uk)
Supervisor: Dr. Kevin Amess (kevin.amess@nottingham.ac.uk)

School's Research Ethics Officer:

Dr. Davide Pero (davide.pero@nottingham.ac.uk)

I consent to the above statements and to participating in this survey.

_____	_____	_____
FULL NAME (IN CAPITAL)	SIGNATURE	DATE

Motivation to participating in the YES Competition 2019

What were your motivations for attending the YES Competition 2019?

	Strongly agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Strongly disagree
Q1.1 To become a business owner					
Q1.2 To implement my knowledge and ideas into practice					
Q1.3 To identify potential alternative careers					
Q1.4 To enhance my employability					
Q1.5 To get access to networks of mentors and entrepreneurs					
Q1.6 To improve my knowledge and skillset in commercialisation					
Q1.7 Dissatisfaction in my professional occupation					
Q1.8 Encouragement from colleagues					

Attitudes towards starting a business

How likely are you to pursue the following careers?

	Extremely likely	Somewhat likely	Neither likely nor unlikely	Somewhat unlikely	Extremely unlikely
Q2.1_T1 Industrial research					
Q2.2_T1 Academic research					
Q2.3_T1 Industrial management					
Q2.4_T1 University management					
Q2.5_T1 Business owner					
Q2.6_T1 Government					

How much confidence do you have in the following abilities?

	Completely confident	Somewhat confident	Neither confident nor not confident	Somewhat not confident	Not confident at all
Q3.1_T1 Know how to place a financial value on a new business					
Q3.2_T1 Pick the right marketing approach for the introduction of a new service/product					
Q3.3_T1 Work with a supplier to get better prices					
Q3.4_T1 Estimate accurately the costs of running a new business					
Q3.5_T1 Recognise when a business idea is feasible					
Q3.6_T1 Recruit the right management employees for a new business					
Q3.7_T1 Recruit the right R&D employees for a new business					
Q3.8_T1 Convince customers to try a new service/product for the first time					

Support in starting a business

How confident are you in accessing the following support when starting your own business?

	Completely confident	Somewhat confident	Neither confident nor not confident	Somewhat not confident	Not confident at all
Q4.1_T1 Support regarding fiscal charges (tax, legal fees, etc.)					
Q4.2_T1 Assistance in assessing business viability					
Q4.3_T1 Legal assistance or counselling					
Q4.4_T1 Organisations to assist business owners					
Q4.5_T1 Support regarding start-up paperwork and bureaucracy					

Expected barriers in starting a business

In your potential career as an entrepreneur, what is the likelihood that you will encounter the following barriers?

	Extremely likely	Somewhat likely	Neither likely nor unlikely	Somewhat unlikely	Extremely unlikely
Q5.1_T1 Difficulties in obtaining finance					
Q5.2_T1 Difficulties in finding co-founders					
Q5.3_T1 Difficulties in attracting the right employees					
Q5.4_T1 Difficulties in identifying customers					
Q5.5_T1 Difficulties in identifying suppliers					
Q5.6_T1 Needing to take time off work when children are sick or on school breaks					
Q5.7_T1 Discrimination by customers/suppliers/investors because I have, or plan to have, children					
Q5.8_T1 Being discouraged from becoming a business owner					
Q5.9_T1 Feeling a conflict between my job and my family					
Q5.10_T1 Allowing my spouse/partner's desire for children to take precedence over my career goals					
Q5.11_T1 Not being able to find good day-care services for my children					
Q5.12_T1 My spouse/partner doesn't approve of my choice to become a business owner					
Q5.13_T1 Feeling guilty about working while my children are young					
Q5.14_T1 Not making as much money as a business owner					
Q5.15_T1 Other people believe that starting a business is not appropriate for me					
Q5.16_T1 Difficulty in continuing my business after taking time off to care for my children					
Q5.17_T1 Difficulty in maintaining the ground gained as a business owner after having children					
Q5.18_T1 Conflict between marriage/family plans and my career plans					
Q5.19_T1 Not having a role model or mentor in my business network					
Q5.20_T1 Experiencing sex discrimination as a business owner					
Q5.21_T1 Not receiving support from my spouse/partner					
Q5.22_T1 Discrimination due to my marital status					
Q5.23_T1 My parents/family don't approve of my choice to become a business owner					
Q5.24_T1 Lack of support from customers/suppliers/investors					
Q5.25_T1 Other business owners have better opportunities/deals/investments					
Q5.26_T1 Believing that being a business owner is not appropriate for me					
Q5.27_T1 Having children at a "bad time" in the development of my business					
Q5.28_T1 Having an inflexible work schedule that interferes with my family responsibilities					
Q5.29_T1 Experiencing sexual harassment as a business owner					
Q5.30_T1 Fear that people will consider my character unsuitable for being a business owner					
Q5.31_T1 Not knowing the "right people" to get my business ahead					
Q5.32_T1 Lack of suitable business opportunities					
Q5.33_T1 My friends don't approve of my choice to become a business owner					

Expected barriers in starting a business (continued)

In your potential career as an entrepreneur, to what extent do you agree with the following statements?

	Strongly agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Strongly disagree
Q6.1_T1 Customers/suppliers lack faith in me as a business owner					
Q6.2_T1 Investors lack faith in me as a business owner					
Q6.3_T1 The people I know do not think I will be successful as a business owner					
Q6.4_T1 I face unfair evaluations of my abilities to run a new business					
Q6.5_T1 I often feel that people look down on me in business settings					
Q6.6_T1 I rarely face unfair judgement as a business owner					
Q6.7_T1 Business success is easier for other people					
Q6.8_T1 I have the ability to run a successful business					
Q6.9_T1 Fear of failure would prevent me from starting a business					

Participant's Information

Please answer the following questions.

	Yes	No
Q7.1 Have your (parents/guardians, siblings or grandparents) ever owned a business?		
Q7.2 Have you ever started a business?		
Q7.2.1 If yes, is the business you started currently operating?		
Q7.3 Have you ever held a paid/non-paid position in a start-up or an entrepreneurial company?		
Q7.4 Have you ever attended any taught modules in business and management?		
Q7.5 Have you ever attended any workshops in business and management?		
Q7.6 Have you ever attended any online courses in business and management?		
Q7.7 Have you ever attended any business plan competition?		

Q8 What is your major of study?

☐ Biosciences ☐ Engineering ☐ Life Science ☐ Pharmacy
☐ Agriculture ☐ Veterinary ☐ Medicine ☐ Other_____

Q9 What is your gender?

☐ Male ☐ Female ☐ Other_____

Q10 Are you from a minority background?

☐ Yes ☐ No

Q11 What are your parents' occupations?

_____

Q12 What is your nationality?

_____

Q13 Is English your mother tougue?

☐ Yes ☐ No

Q14 What is your marital status?

☐ Married ☐ Partnered ☐ Single ☐ Divorced ☐ Widowed

Q15_T1 Please provide your contact e-mail for matching the pre- and post-results.

_____

B. Post-Questionnaire

Post-Questionnaire

Information for Research Participants

This is the follow-up survey from the questionnaire you have completed before attending the YES Competition. This post-survey aims to evaluate the possible impact of the YES Competition 2019 on your career interest, attitudes, perceived support and barriers towards entrepreneurship as a potential career.

This post-survey will take no longer than 10 minutes to complete.

Your consent was obtained during the pre-survey. You can refer back to the pre-survey, Participant Information Sheet and Consent Form via this URL:
https://nottingham.qualtrics.com/jfe/form/SV_cBAxRPMbJqr4QoB

Should you have any questions, please refer to the following contact details.

Researcher: Sahattaya Achtzehn (sahattaya.achtzehn@nottingham.ac.uk)
Supervisor: Dr. Lorna Treanor (lorna.treanor@nottingham.ac.uk)
Supervisor: Dr. Kevin Amess (kevin.amess@nottingham.ac.uk)
Research ethics officer: Dr. Davide Pero (davide.pero@nottingham.ac.uk)

Thank you very much in advance for your participation in my PhD research project.

Attitudes towards starting a business

How likely are you to pursue the following careers?

	Extremely likely	Somewhat likely	Neither likely nor unlikely	Somewhat unlikely	Extremely unlikely
Q2.1_T2 Industrial research					
Q2.2_T2 Academic research					
Q2.3_T2 Industrial management					
Q2.4_T2 University management					
Q2.5_T2 Business owner					
Q2.6_T2 Government					

How much confidence do you have in the following abilities?

	Completely confident	Somewhat confident	Neither confident nor not confident	Somewhat not confident	Not confident at all
Q3.1_T2 Know how to place a financial value on a new business					
Q3.2_T2 Pick the right marketing approach for the introduction of a new service/product					
Q3.3_T2 Work with a supplier to get better prices					
Q3.4_T2 Estimate accurately the costs of running a new business					
Q3.5_T2 Recognise when a business idea is feasible					
Q3.6_T2 Recruit the right management employees for a new business					
Q3.7_T2 Recruit the right R&D employees for a new business					
Q3.8_T2 Convince customers to try a new service/product for the first time					

Support in starting a business

How confident are you in accessing the following support when starting your own business?

	Completely confident	Somewhat confident	Neither confident nor not confident	Somewhat not confident	Not confident at all
Q4.1_T2 Support regarding fiscal charges (tax, legal fees, etc.)					
Q4.2_T2 Assistance in assessing business viability					
Q4.3_T2 Legal assistance or counselling					
Q4.4_T2 Organisations to assist business owners					
Q4.5_T2 Support regarding start-up paperwork and bureaucracy					

Expected barriers in starting a business

In your potential career as an entrepreneur, what is the likelihood that you will encounter the following barriers?

	Extremely likely	Somewhat likely	Neither likely nor unlikely	Somewhat unlikely	Extremely unlikely
Q5.1_T2 Difficulties in obtaining finance					
Q5.2_T2 Difficulties in finding co-founders					
Q5.3_T2 Difficulties in attracting the right employees					
Q5.4_T2 Difficulties in identifying customers					
Q5.5_T2 Difficulties in identifying suppliers					
Q5.6_T2 Needing to take time off work when children are sick or on school breaks					
Q5.7_T2 Discrimination by customers/suppliers/investors because I have, or plan to have, children					
Q5.8_T2 Being discouraged from becoming a business owner					
Q5.9_T2 Feeling a conflict between my job and my family					
Q5.10_T2 Allowing my spouse/partner's desire for children to take precedence over my career goals					
Q5.11_T2 Not being able to find good day-care services for my children					
Q5.12_T2 My spouse/partner doesn't approve of my choice to become a business owner					
Q5.13_T2 Feeling guilty about working while my children are young					
Q5.14_T2 Not making as much money as a business owner					
Q5.15_T2 Other people believe that starting a business is not appropriate for me					
Q5.16_T2 Difficulty in continuing my business after taking time off to care for my children					
Q5.17_T2 Difficulty in maintaining the ground gained as a business owner after having children					
Q5.18_T2 Conflict between marriage/family plans and my career plans					
Q5.19_T2 Not having a role model or mentor in my business network					
Q5.20_T2 Experiencing sex discrimination as a business owner					
Q5.21_T2 Not receiving support from my spouse/partner					
Q5.22_T2 Discrimination due to my marital status					
Q5.23_T2 My parents/family don't approve of my choice to become a business owner					
Q5.24_T2 Lack of support from customers/suppliers/investors					
Q5.25_T2 Other business owners have better opportunities/deals/investments					
Q5.26_T2 Believing that being a business owner is not appropriate for me					
Q5.27_T2 Having children at a "bad time" in the development of my business					
Q5.28_T2 Having an inflexible work schedule that interferes with my family responsibilities					
Q5.29_T2 Experiencing sexual harassment as a business owner					
Q5.30_T2 Fear that people will consider my character unsuitable for being a business owner					
Q5.31_T2 Not knowing the "right people" to get my business ahead					
Q5.32_T2 Lack of suitable business opportunities					
Q5.33_T2 My friends don't approve of my choice to become a business owner					

Expected barriers in starting a business

In your potential career as an entrepreneur, to what extent do you agree with the following statements?

	Strongly agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Strongly disagree
Q6.1_T2 Customers/suppliers lack faith in me as a business owner					
Q6.2_T2 Investors lack faith in me as a business owner					
Q6.3_T2 The people I know do not think I will be successful as a business owner					
Q6.4_T2 I face unfair evaluations of my abilities to run a new business					
Q6.5_T2 I often feel that people look down on me in business settings					
Q6.6_T2 I rarely face unfair judgement as a business owner					
Q6.7_T2 Business success is easier for other people					
Q6.8_T2 I have the ability to run a successful business					
Q6.9_T2 Fear of failure would prevent me from starting a business					

Participant's Information

Q15_T2 Please provide your contact e-mail for matching the pre- and post-results.

_____

C. Codebook (Quantitative Study)

Variable	Variable Label	Value Labels
ID	Respondent ID	001…120
EEC	EEC_Participation	0 = before attending the EEC 1 = after attending the EEC
Q1.1_T1 … Q1.7_T1	Q.1.1_T1_Motivation…Q1.7_T1_Motivation	1 = strongly disagree 2 = somewhat disagree 3 = neither agree nor disagree 4 = somewhat agree 5 = strongly agree
Q2.1_T1 … Q2.6_T1	Q.2.1_T1_Intentions…Q2.6_T1_Intentions	1 = extremely unlikely 2 = somewhat unlikely 3 = neither likely nor unlikely 4 = somewhat likely 5 = extremely likely
Q2.1_T2 … Q2.6_T2	Q.2.1_T2_Intentions…Q2.6_T2_Intentions	1 = extremely unlikely 2 = somewhat unlikely 3 = neither likely nor unlikely 4 = somewhat likely 5 = extremely likely
Q3.1_T1 … Q3.8_T1	Q3.1_T1_Efficacy … Q3.8_T1_Efficacy	1 = not confident at all 2 = somewhat not confident 3 = neither confident nor… 4 = somewhat not confident 5 = completely confident
Q3.1_T2 … Q3.8_T2	Q3.1_T2_Efficacy … Q3.8_T2_Efficacy	1 = not confident at all 2 = somewhat not confident 3 = neither confident nor… 4 = somewhat not confident 5 = completely confident
Q4.1_T1 … Q4.5_T1	Q4.1_T1_Barrier … Q4.5_T1_Barrier	1 = not confident at all 2 = somewhat not confident 3 = neither confident nor… 4 = somewhat not confident 5 = completely confident
Q4.1_T2 … Q4.5_T2	Q4.1_T2_ Barrier … Q4.5_T2_ Barrier	1 = not confident at all 2 = somewhat not confident 3 = neither confident nor… 4 = somewhat not confident 5 = completely confident
Q5.1_T1 … Q5.33_T1	Q5.1_T1_ Barrier … Q5.33_T1_ Barrier	1 = extremely unlikely 2 = somewhat unlikely 3 = neither likely nor unlikely 4 = somewhat likely 5 = extremely likely
Q5.1_T2 … Q5.33_T2	Q5.1_T2_ Barrier … Q5.33_T2_ Barrier	1 = extremely unlikely 2 = somewhat unlikely 3 = neither likely nor unlikely 4 = somewhat likely 5 = extremely likely
Q6.1_T1 … Q6.9_T1	Q6.1_T1_ Barrier … Q6.9_T1_ Barrier	1 = strongly disagree 2 = somewhat disagree 3 = neither agree nor disagree 4 = somewhat agree 5 = strongly agree

Variable	Variable Label	Value Labels
Q6.1_T2 … Q6.9_T2	Q6.1_T2_ Barrier … Q6.9_T2_ Barrier	1 = strongly disagree 2 = somewhat disagree 3 = neither agree nor disagree 4 = somewhat agree 5 = strongly agree
Q7.1 … Q7.7	Q7.1_Exposure … Q7.7_Exposure	1 = yes 0 = no
Q8	Q8_Major	1 = bioscience 2 = engineering 3 = life science 4 = pharmacy 5 = agriculture 6 = veterinary 7= medicine 8 = other
Q9	Q9_Gender	1 = male 2 = female 3 = other
Q10	Q10_Minority	1 = yes 0 = no
Q11	Q11_Socio-Economic*	0 = non-working 1 = working class 2 = skilled working class 3 = lower middle class 4 = middle class 5 = upper middle class
Q12	Q12_Nationality	0 = non-British 1 = British
Q13	Q13_English	1 = yes 0 = no
Q14	Q14_Marital	1 = married 2 = partnered 3 = single 4 = divorced 5 = widowed
Q15_T1	Q14_T1_Email	Respondent ID
Q15_T2	Q14_T2_Email	Respondent ID

*The arrangement of demographic grouping is based on NRS Social Grade primarily used within the United Kingdom. One of the parents with the highest social grade will be coded.

- Upper middle class = higher managerial, administrative or professional
- Middle class = intermediate managerial, administrative or professional
- Lower middle class = supervisory and junior managerial, administrative or professional
- Skilled working class = skilled manual workers
- Working class = semi and unskilled manual workers
- Non-working = casual or lowest grade workers, pensioners and those who are dependent on welfare state for their income

D. Interview Schedule

Opening/Motivations:

Q1.1 How did you hear about the YES Competition? Why did you participate in it?
Q1.2 Were you asked by your colleagues or suggested by your faculties to join this competition?
Q1.3 Did your team have its business idea selected before the competition workshop? Was this the same business idea that you pitched on the last day? If not, why not?
Q1.4 Had you developed the idea and business plan/pitch to any extent before the workshop?
Q1.5 Did you have any help or support from within your University?

Prior entrepreneurial exposure and intention:

Q2.1 If you were asked to describe an entrepreneur, what do you think of?
Q2.2 Do you think entrepreneurs are regarded positively or negatively in our society?
Q2.3 What is your view of entrepreneurship as a career?
Q2.4 What are your career aspirations[11]?
Q2.5 Do you want to start a business at some point in your life? If yes, why and when?
Q2.6 Does anyone in your family, or your friendship circle, have their own business?
Q2.7 Do they have any influence on your interest in starting a business?
Q2.8 Having participated in YES, did the competition have any influence on your interest in starting a business?
Q2.9 Have you had any experience working in start-ups, starting your own business or attending business and management courses before attending the YES programme?
Q2.10 Do these experiences influence your interest in starting a business in the future?

Entrepreneurial self-efficacy:

Q3.1 What traits and skills do you think a successful business owner needs to have?
Q3.2 Would you say you had those same traits and skills before attending the YES competition?
Q3.3 Were there specific traits and skills you expected to develop or improve as a result of taking part in YES?
Q3.4 Did the competition improve these traits and skills? Examples.
Q3.5 Did YES change your perceptions of the traits and skills a business owner needs?
Q3.6 How would you compare yourself to other participants on those traits and skills?

Career barriers and stereotype threat in STEMM fields:

Q4.1 Could you describe your experience as a female PhD student/ECR?

[11] *This question aims to specifically determine participant's career aspiration to, for example, start their own business, commercialise their research, or involve in academic spinouts. The underlined term will be clarified accordingly.*

Q4.2 Are there any advantages to being a woman scientist?
Q4.3 What are the main challenges you face as a woman scientist?
Q4.4 Do you think women in science face barriers in terms of career progression?
Q4.5 Do you expect to encounter any barriers as a woman scientist, or have you?
Q4.6 Do you have any role models? Who?
Q4.7 Who are the major influencers in your career decisions?

Career barriers and stereotype threat in entrepreneurship:

Q5.1 What do you think the main challenges are for someone starting or running a business?
Q5.2 Do you think women would face any particular challenges starting or running a business? Did the competition change your perception?

Supports in entrepreneurship and experience during the competition:

Q6.1 If you would like to start a business, what kind of support you would require? Do you have access to this support and/or do you know where to find it? Did the competition offer you any support?
Q6.2 What challenges did you face during the competition? What are your most and least favourite parts? How can it be improved?

Closing/Entrepreneurial intentions:

Q7.1 Did your future career aspiration change after the competition? Why?
Q7.2 What were your main takeaways from the competition?
Q7.3 Were you interested in participating in YES to identify other potential career options?
Q7.4 Do you think your gender influence your experience during the competition? Do you think your gender will affect your future career decision and advancement?

E. Coding Categories and Sub-Categories (Qualitative Study)

Coding Categories	Coding Sub-Categories
Motivation to Participation (MOV)	→ Entrepreneur (MOV – ENT) → Implementation (MOV – IMP) → Alternative Careers (MOV – ALT) → Employability (MOV – EMP) → Networks and Mentors (MOV – NET) → Knowledge and Skills (MOV – KNO) → Dissatisfaction (MOV – DIS) → Colleagues (MOV – COL)
Prior Entrepreneurial Exposure (Pre-Ex)	→ Family Business (Pre-Ex – FAM) → Own Business (Pre-Ex – ENT) → Work in Start-ups (Pre-Ex – EMP) → Taught EE Modules (Pre-Ex – TAT) → Workshop in EE (Pre-Ex – WOP) → Online EE (Pre-EX – ONL) → Business Plan Competition (Pre-Ex – EEC)
Pre-Education Entrepreneurial Intentions (Pre-EI)	→ Not Interested (Pre-EI – LOW) → Somewhat Interested (Pre-EI – MED) → Highly Interested (Pre-EI – HIGH)
Post-Education Entrepreneurial Intentions (Post-EI)	→ Not Interested (Post-EI – LOW) → Somewhat Interested (Post -EI – MED) → Highly Interested (Post-EI – HIGH)
Entrepreneurial Self-Efficacy (ESE)	→ Finance (ESE – FIN) → Marketing (ESE – MAR) → Supplier Management (ESE -- SUP) → Cost Estimation (ESE – COS) → Business Idea Evaluation (ESE – IDE) → Recruiting Management (ESE – MAN) → Recruiting R&D (ESE – RND) → Persuasion (ESE – PER)
Perceived Barriers to Entrepreneurship (BAR)	→ Stereotype Threat (BAR – STE) → Sex Discrimination (BAR – DIS) → Family and Peers (BAR – FNP) → Role Models (BAR – ROL) → Mentors (BAR – MET) → Administrative Support (BAR – AMN) → Obtaining Finance (BAR – FIN) → Identifying Stakeholders (BAR – STK) → Fear of Failure (BAR – FOF) → Entrepreneurial Self-Efficacy (BAR – ESE)

F. Attributes and Values for Case Classification (Qualitative Study)

Attribute	Value
PhD Major	Bioscience Engineering Life science Pharmacy Agriculture Veterinary Medicine Other
Nationality	British Non-British
Minority Background	With Minority Background Without Minority Background
Socio-Economic Status	Non-working Working class Skilled working class Lower middle class Middle class Upper middle class
First Language	English Other
Marital Status	Married Partnered Single Divorced Widowed
Motivation to Participation in EEC	Entrepreneur (MOV – ENT) Implementation (MOV – IMP) Alternative Careers (MOV – ALT) Employability (MOV – EMP) Networks and Mentors (MOV – NET) Knowledge and Skills (MOV – KNO)
Prior Entrepreneurial Exposure	Family Business Own Business Work in Start-ups Taught EE Modules Workshop in EE Online EE Business Plan Competition
Pre-Education Entrepreneurial Intentions	Low Pre-EI Medium Pre-EI High Pre-EI
Post-Education Entrepreneurial Intentions	Low Post-EI Medium Post-EI High Post-EI

G. Participants Information Sheet

Nottingham University Business School
UNITED KINGDOM · CHINA · MALAYSIA

Information for Research Participants

Your participation in this research should be voluntary, and you may change your mind about being involved in the research at any time, and without giving a reason.

This information sheet is designed to give you full details of the research project, its goals, the research team, the research funder, and what you will be asked to do as part of the research. If you have any questions that are not answered by this information sheet, please ask the researcher or the supervisors via the contact details at the end of this information sheet.

This research has been reviewed and given favourable opinion by the Nottingham University Business School Research Ethics Committee.

What is the research project called?

The Impact of Entrepreneurship Education upon Entrepreneurial Intentions of STEMM Women Early Career Researchers

Who is carrying out the research?

My name is Sahattaya Achtzehn, a PhD student in Entrepreneurship and Management at Nottingham University Business School.

This doctoral research is being supervised by Dr. Lorna Treanor and Dr. Kevin Amess, Nottingham University Business School.

What is the research about?

I would like to find out how early career researchers (ECRs) in Science, Technology, Engineering, Mathematics and Medicine (STEMM) develop their attitude towards entrepreneurship as a potential career choice before, during and after attending a business plan competition.

More specifically, I would like to establish how a business plan competition might influence attitudes and intentions towards entrepreneurship as a potential career choice.

What groups of people have been asked to take part, and why?

I am inviting ECRs who attended the Young Entrepreneurs Scheme (YES) Competition 2019 to be involved. The YES Competition is one of the first business plan competitions designed specifically for STEMM ECRs across higher education (HE) institutions in the UK.

What will research participants be asked to do?

You are being asked to complete pre- and post-online questionnaires. You will be asked about your educational background, some personal background information, your motivation for participating in YES Competition, your experience of participating in YES and your attitude towards entrepreneurship as a potential career choice.

What will happen to the information I provide?

The data will be collected and treated confidentially and the name of your institution will not be asked for. Your contact e-mail will be asked in both pre- and post-questionnaires to match the pre- and post-results. At the end of the questionnaire you will be asked whether you are willing for us to contact you to either discuss your responses or

to research further the experiences before, during and after participating in the business plan competition.

I am committed to carrying out my research according to The University of Nottingham Code of Research Conduct and Research Ethics (2016) and the ethical guidelines provided by the British Educational Research Association (online at https://www.bera.ac.uk/researchers-resources/publications/ethical-guidelines-for-educational-research-2018). I will also conform to General Data Protection Regulations.

What will be the outputs of the research?

Only my supervisors and I will have access to the raw data. All information collected while carrying out the study will be stored in a password protected folder on a University of Nottingham server. All data will be anonymised and no individual will be identifiable from any published findings.

Primarily, the data will inform my PhD thesis. Additionally, it is intended that my research findings will be disseminated through academic publications such as peer reviewed journal articles, book chapters, conference papers etc.

Contact details

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Complaint procedure

If you wish to complain about the way in which the research is being conducted or have any concerns about the research then in the first instance please contact the *supervisors* or contact the School's Research Ethics Officer:

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H. Principal Component Factor Analysis (Varimax Rotation) of Perceived Barriers Subscales and Factor Loadings

Item No. Perceived Barriers Items*	1	2	3	4	5	6	7
21. Difficulty in continuing my business after taking time off to care for my children	.865						
22. Difficulty in maintaining the ground gained as a business owner after having children	.854						
18. Feeling guilty about working while my children are young	.812						
11. Needing to take time off work when children are sick or on school breaks	.807						
32. Having children at a "bad time" in the development of my business	.807						
33. Having an inflexible work schedule that interferes with my family responsibilities	.778						
16. Not being able to find good day-care services for my children	.777						
14. Feeling a conflict between my job and my family	.733						
23. Conflict between marriage/family plans and my career plans	.643						
5. Support regarding start-up paperwork and bureaucracy		.860					
4. Organisations to assist business owners		.806					
2. Assistance in assessing business viability		.791					
1. Support regarding fiscal charges (tax, legal fees, etc.)		.785					
3. Legal assistance or counselling		.778					
28. My parents/family don't approve of my choice to become a business owner			.809				
17. My spouse/partner doesn't approve of my choice to become a business owner			.747				
26. Not receiving support from my spouse/partner			.745				
45. Business success is easier for other people				.757			
35. Fear that people will consider my character unsuitable for being a business owner				.752			
31. Believing that being a business owner is not appropriate for me				.703			
47. Fear of failure would prevent me from starting a business				.648			
34. Experiencing sexual harassment as a business owner					.898		
25. Experiencing sex discrimination as a business owner					.853		
27. Discrimination due to my marital status					.639		
9. Difficulties in identifying customers						.821	
10. Difficulties in identifying suppliers						.787	
7. Difficulties in finding co-founders						.651	
39. Customers/suppliers lack faith in me as a business owner							.854
40. Investors lack faith in me as a business owner							.816
41. The people I know do not think I will be successful as a business owner							.601

*Item no. 36, 38, 24 and 6 are single-item barriers and therefore are not included for the factor analysis