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Token entrepreneurs: a review of gender, capital, and context in technology entrepreneurship

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ABSTRACT

This article reviews the literature on gender and entrepreneurship in technology to explore individual and contextual factors maintaining the token status of women in this field. It examines how the intersection of gender and context influences participation rates in entrepreneurship, and suggests that the deeply embedded cultural and cognitive associations that frame both technology and entrepreneurship as masculine concepts create barriers for women when these contexts overlap. It offers a framework for research and practice that aids in the analysis of complex multi-level barriers that control access to the forms of capital necessary for initial and continued participation in technology entrepreneurship. Given calls for women to participate more fully in high-growth technology ventures, it highlights the need for research to incorporate broader analytical perspectives that simultaneously examine both the barriers faced by women in these contexts and the factors that systemically sustain them.

KEYWORDS

Entrepreneurship; technology; gender; women; capital; startups; literature review

Introduction

The future of American entrepreneurship and growth is in the hands of women. (Robb, Coleman, and Stangler 2014, 3)

It has been over 40 years since the first journal article about women in entrepreneurship was published (Schwartz 1976). In the four decades since that initial article appeared, the number of women working as entrepreneurs both globally and in the USA has grown considerably, as has the attention given to them by researchers (see Brush 1992; Gatewood et al. 2003; Sullivan and Meek 2012). It has been estimated that there were approximately 9.4 million women-owned enterprises in the USA alone in 2015 (American Express OPEN Forum 2015), and as many as 207 articles touching on women in entrepreneurship appearing in academic journals between 1976 and 2010 (Gatewood et al. 2003; Sullivan and Meek 2012). While involvement and attention to gender within entrepreneurship have increased, these are viewed by many as insufficient given economic and workforce trends and the potential that remains for women to be more fully represented in technology-related fields.

The economy has experienced significant transformations in this 40-year timeframe, increasingly shifting away from the production of material goods and towards the commercialization of knowledge, information and technological innovations (Best et al. 2016; Chandan 2015; Duderstadt, Wulf, and Zemsky 2005; Etzkowitz et al. 2000; Nye 2006; Truss et al. 2012; Walby 2011). Entrepreneurship is increasingly considered to be 'one of the most important activities of modern economic life' (Fairlie et al. 2015, 3).

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Working to meet the demands of the new 'innovation economy' (Kenney and Patton 2015; Wendler et al. 2010), entrepreneurs are more conceptually linked with technology and high-tech enterprises than ever before given their role in job creation (Dohrman 2010; Hsu, Roberts, and Eesley 2007; Kenney and Patton 2015; Shartrand et al. 2010; Wendler et al. 2010; Wiens and Jackson 2015).

However, participation in the creation of high-growth, innovation- and technology-based ventures is not reflected equally across gender lines. Female entrepreneurs are underrepresented in the more profitable, faster-growing types of entrepreneurship that are increasingly valued by this new economy (GEM 2010; Kelley et al. 2012). Reports indicate that the number of women entering these fields as entrepreneurs has remained relatively unchanged since 2004 (Kelley et al. 2014). Despite extensive work done to generate female participation in entrepreneurship generally (Bygrave et al. 2013; Karimi et al. 2013; Obschonka, Schmitt-Rodermund, and Terracciano 2014; Pettersson and Lindberg 2013; Ranga and Etzkowitz 2010; Stephan and El-Ganainy 2007), and to raise awareness of gender disparities in technology entrepreneurship globally (Dautzenberg 2012; Ezzedeen and Zikic 2012; Hampton, McGowan, and Cooper 2011; Orser and Hogarth-Scott 2009; Sappleton 2009), females in highly developed economies with advanced technological infrastructures remain 'token' or minority players in what is still a fundamentally masculine field.

Persistent gender gaps suggest that our examinations of them, and/or our assumptions about which factors are contributing to gendered inequalities and disparities in participation, are insufficient. This was recognized in a recent GEM report which called for more research that incorporates the contextually significant variables that underlie and sustain gender-based disparities (Herrington and Kew 2017). Specifically, the report stated that in order to create and implement more effective strategies for overcoming persistent gender gaps in entrepreneurship, scholars must first 'acknowledge and take into account multiple perspectives and the particular context of specific economies (including the development profile, national culture, and political and social dynamic)' (Herrington and Kew 2017, 11).

In light of this, the goal of this literature review is to examine the factors that sustain persistent gender disparities in participation and success in contexts where technology and entrepreneurship intersect – i.e. in technology entrepreneurship. The rationale for examining this particular area of entrepreneurship is not that the technology sector itself is distinctive (although it is a context with unequal rates of participation by gender – see Henwood 2000; Walby 2011), it's that 'technology entrepreneurship' is a field where gendered contexts intersect or overlap (i.e. both technology AND entrepreneurship are gendered). Industry segregation patterns shows that even when women overcome the barriers of one gendered context (entrepreneurship), they tend to remain in sectors that are stereotypically female (e.g. service or retail) instead of the more lucrative sectors associated by many cultures with men and masculinity (like technology – GEM 2010; Kelley et al. 2012). Therefore, it is important to recognize the layered nature of barriers found in overlapping gendered contexts in order to increase our understanding of persistent and systemic gender gaps, and then address them more fully in initiatives focused on moving women in entrepreneurship beyond just the typically 'feminine' sectors to the more lucrative technology-based 'masculine' sectors as well.

To examine these topics, we first introduce background from existing research on the barriers faced by women in both technology and entrepreneurship contexts. Second, we present the methods used to conduct a review of the literature focused on gender in contexts where technology and entrepreneurship intersect. Third, we describe the procedures used to evaluate the articles, examine the variables found to influence participation and/or persistence of women as entrepreneurs in technology and innovation contexts, and the data-driven inductive approach used to identify patterns and explore the connections between them. Lastly, we discuss our analysis using a multi-level framework of internal and external barriers that regulate access to the various forms of capital necessary for initial and sustained participation in this context. This framework shows barriers as layered concepts that can be encountered in multiple forms, with additive or multiplicative consequences, particularly in contexts where identities intersect and stereotypes overlap. Finally, it suggests that developing long-term solutions for systemic and

persistent inequalities requires expanding perspectives to recognize and address them in both research and practice.

Women and technology

> *If machismo is on the run in most U.S. corporate settings, then [technology] is its Alamo – a last holdout of redoubled intensity*. (Hewlett et al. 2008, 23)

The concept of technology is not gender neutral (Henwood 2000; Walby 2011). Like most concepts, technology could only exist as a neutral entity if the sociocultural context and issues surrounding it were removed (Green 2002). However, 'no technology is, has been, or [ever] will be a "natural force" … Technologies are not foreign to "human nature" but inseparable from it' (Nye 2006, 19). Ultimately, technology is a social process that reflects the larger relationships and socially constructed systems of meaning that surround it (Nye 2006). As such, the deeply embedded cultural associations linking technology with men and masculinity in many contemporary Western contexts influence the 'everyday experiences of gender, historical narratives, employment practices, education, and the distribution of power across a global society in which technology is seen as the driving force of progress' (Bray 2007, 38).

On an applied level, this translates into the gendered acquisition of skills, expertise, and divisions of labour that continue to place men at the centre of technology and innovation, and frame women primarily as its passive recipients (Bilimoria, Joy, and Liang 2008; Bray 2007; Kelan 2007). Progress has been made in understanding the effects of gender stereotypes on the performance of females, especially in traditionally male-dominated contexts (Hill, Corbett, and St. Rose 2010); however, research indicates that participation rates of women in technology fields remain low despite the measures taken to fix the so-called leaky pipeline (Bilimoria, Joy, and Liang 2008; Hewlett et al. 2008). Systemic and institutionalized biases that sustain traditional divisions of labour by gender continue to impact the recruitment and retention of women into the very educational programmes and jobs that provide the skills necessary to eliminate gender gaps and reduce technology's masculine stereotypes (Godwin, Stevens, and Brenner 2006; Goel, Goktepe-Hulten, and Ram 2014; Orser and Hogarth-Scott 2009).

Women and entrepreneurship

Although a seemingly modern concept, the historical roots of entrepreneurship have been developed over the last 300 years by a long – and almost exclusively male – line of scholars and philosophers (Jones 2012; Nightingale and Coad 2011). As a field where the sex of an individual often determines perceptions about ability and access to the skills and resources needed to start and grow a business, entrepreneurship suffers from many of the same complex and culturally masculine associations that have hindered the full participation of females in technology (Bury 2011; Goss et al. 2011; Rindova, Barry, and Ketchen 2009; Zott and Nguyen Huy 2006). Over time, imbalanced distributions of skills and resources that result from greater access to education and opportunities to practice entrepreneurship have resulted in the discipline becoming implicitly associated with men and the characteristics ascribed to masculinity. Ely and Padavic (2007) sum up the self-replicating nature of this process, stating that 'the result is a hierarchal system in which the dominant group maintains control over the distribution of resources' (1128) and thereby remains deeply associated with the category and idealized as more inherently legitimate.

This conflation between stereotypically masculine traits, the skills used to define a successful entrepreneur, and the subsequently lowered expectations about the ability of women as entrepreneurs has resulted in 'covert discriminatory practices' (Kelley et al. 2012) that impact female career intent, self-efficacy, and the types of entrepreneurial ventures chosen by women in contexts such as the USA. The stereotypes framing men as more natural and more successful entrepreneurs have

huge financial implications for women entrepreneurs as individuals, as well as to the growth of the national and global economies they are a part of (Jones 2012). Disproportionate levels of access to, and development of, entrepreneurial skills and careers in technology-related sectors by women have contributed to diminished business creation rates and fiscal growth, despite the growing population of well-educated women workers in the USA (Jones 2012).

Intersecting contexts and overlapping barriers

> *Most women expressed some variation on believing "entrepreneurs" and "support for entrepreneurs" to be for young, male entrepreneurs in the tech sector who are looking for venture capital money.* (North, A. 2015, para. 8)

The term 'token' is used in this article to mean more than just minority status or a problem of numbers and momentum that will resolve itself once more members of the missing group are added to the equation (Kanter 1977). More significantly, the term is used to highlight the inadequacy of scholarship and policies that superficially address inequalities by universalizing diverse experiences into a single social group, identity category, or context to simplify the search for causal explanations and concrete solutions (Scott 1986; Zimmer 1988). For example, reasoning that assumes research on women as entrepreneurs to be generalizable for all types of women in all types of entrepreneurship is over-simplified; 'women' are not a homogeneous group any more than 'men' are (Symington 2004), and neither is 'entrepreneurship' (Bruyat and Julien 2000).

Studies that overlook context (Lansky 2000) and within-group differences (Nelson and Duffy 2010) perpetuate problematic assumptions. These include the tendency to assess gender gaps with deficit models that frame males as the standard for entrepreneurs (Byrne and Fayolle 2010; Marlow and Mcadam 2015; Mirchandani 1999), or the use of conflated categories (like 'women and minorities') that 'effectively equate "women" with "well-to-do White women,"' thereby obscuring the additional inequalities faced by female entrepreneurs of diverse backgrounds (McConnell-Ginet 2003, 70; Eckert and McConnell-Ginet 2013; Ozkazanc-Pan 2014). The opportunities, resources, and career paths available to women, as well as the types of barriers constraining them, inevitably vary in relation to the multiple layers of identity each individual embodies – such as their race, age, sexual orientation, and socioeconomic status (De Clercq and Voronov 2008; Dubrow 2008; Symington 2004). Aspects of these intersecting social categories become more or less salient in different settings (Steele, Spencer, and Aronson 2002), and the identities useful to women in one context can simultaneously disadvantage them in others (Collins 2008; Symington 2004). The overlap of more than one gendered context (e.g. combining both entrepreneurship and technology) creates barriers reinforced with 'multiple marginalities' (Turner 2002) that are substantially more complex to navigate or overcome.

Understanding how gender, technology, and entrepreneurship intersect to form contextually unique participation barriers for women is useful for a variety of reasons. For example, the USA is celebrated as the global leader in high-tech entrepreneurship (Coy 2015; Florida 2014) and is home to four of the world's top five startup cities (Florida 2014; Herrmann et al. 2015). Yet within this context, technology-based ventures are often better known for their pervasive sexism and lack of diversity than their innovativeness in attracting the new populations needed to fuel and sustain future growth (Burleigh 2015, para.1; see also Bercovici 2015; Corbyn 2015; Dusenbery and Pasulka 2012; Gongloff 2014; Griswold 2016; Hu 2013; Kang 2015; Kasperkevic 2016; Khazan 2015; Knowles 2012; Lobo 2014; Sandberg 2013; Staff 2015; Stillman 2016; Stromberg 2015; Tasneem 2012; Vassallo et al. 2016; Williams and Dempsey 2012; Yeh 2012).

The potential exclusion of approximately half the USA population from careers considered to be the key drivers of economic growth is concerning on multiple levels (Acs and Szerb 2010; Fazio et al. 2016; Horn and Pleasance 2012; Morelix, Reedy, and Russell 2016). Those concerned about the collective economic well-being of the nation cite growing doubts about the ability of the USA to keep pace in an increasingly innovation-based global economy, unless it can also significantly increase the number and diversity of participants in its high-growth types of entrepreneurship

(Andes and Castro 2009; Fingleton 2013; Horn and Pleasance 2012; Lohr 2009; Mangelsdorf 2011; Savitz 2013). In an economic future where entrepreneurship may become the only sure way to get and keep a job (Network for Teaching Entrepreneurship 2013), overcoming the barriers that constrain diversity in the most lucrative fields of enterprise becomes an imperative if we hope to avoid further exacerbating the 'feminization [and racialization] of poverty' (Chant 2006).

Review of the literature

To conduct this literature review, procedures similar to those used in the most commonly cited, broad reviews of studies on women in entrepreneurship were used (Brush 1992; Gatewood et al. 2003, Greene et al. 2003; Sullivan and Meek 2012). Limiting the search for relevant articles on women and technology entrepreneurship to the most frequently cited entrepreneurship and small business journals (Greene et al. 2003) returned very few results. The interdisciplinary nature of this topic required searching a much broader range of publications in a variety of study areas, combined with an iterative 'snowballing' technique (i.e. reviewing bibliographies and relevant citations to identify other topically relevant articles) to assemble enough of the existing literature to produce an overview of the research that has been done on this subject.

Procedures and boundary conditions

Using an online database containing full-text, peer-reviewed journal articles, scholarly dissertations and empirical research reports, the search terms[1]: 'gender', 'female' and 'women' along with 'entrepreneurship' and 'technology' and their derivations were searched. Following the example of previous studies (Bastedo 2010; Brush et al. 2014; Goel, Goktepe-Hulten, and Ram 2014; Prowess 2007; Robb, Coleman, and Stangler 2014; Sweida and Reichard 2013; Tinkler et al. 2015; Tracy 2011), derivations for technology ventures included the terms 'high-tech', 'high-growth', 'innovation-driven', 'high-impact' and 'high-potential'; similarly, derivations for entrepreneurship included 'small-to-medium enterprise (SME)', 'venture', 'company', 'enterprise', '(small) business', 'firm', and 'startups' (Acs, Parsons, and Tracy 2008; Aulet and Murray 2013; Brush 1992; Dautzenberg 2012; Greene 2014; Greene et al. 2003; Henrekson and Johansson 2008; Nightingale and Coad 2011; Tracy 2011).

Search query results were narrowed using filters to weed out duplicates and return only peer-reviewed articles and reports written in English. Though no filters for date were set, all of the articles most relevant to this topic were published after 2001. Our original objective was to fill an existing gap in the literature by populating the review primarily with research articles on empirical studies of female populations in the USA; however, excluding research situated outside of the USA left too few peer-reviewed journal articles on this topic to conduct a comprehensive review. Consequently, articles using international samples that included the USA as well as studies done on populations in countries with economies comparable to that of the USA were included. This process resulted in a total of 50 articles containing a least two of the three key search terms ('gender', 'technology', and 'entrepreneurship').

In summary, 18 articles explicitly examined the role of gender in the field of technology entrepreneurship, and 6 more articles described studies conducted in the related subfield of academic entrepreneurship (specifically gender and patenting, technology transfer, and research commercialization in STEM-related academic settings); 12 articles discussed recent studies that looked at gender and entrepreneurship more broadly, but included technology as one of the sectors under examination; the final 14 articles described relevant studies that examined the interplay between gender and technology generally, or in STEM participation and technology-related careers specifically. The 24 articles that described empirical studies AND contained all three search terms were used as the primary basis for this literature review. These articles are summarized in the Appendix.

Content analysis and categorization

Content analysis was done with the articles selected for inclusion in this literature review using NVivo. A preliminary analysis deductively coded the content for surface data on research context, population sample, theories and methods used, independent and dependent variables examined, and key findings from each study (Appendix) (Krippendorff 2004; Stemler 2001). A second stage of analysis then inductively coded a subset of this data (factors found to be limiting participation of women in technology entrepreneurship – i.e. 'barriers') for latent content to evaluate any relationships or similarities and differences between them, and to determine any emergent patterns, dimensions or themes in the research findings (Krippendorff 2004; Shapiro and Markoff 1997; Stemler 2001). Barriers were categorized into three dimensions: location of barrier, level of barrier, and type of barrier. The properties and scope of these dimensions were developed further by adding subgroups to expand their descriptive value (Table 1), and by exploring the boundaries of the subgroups in relation to one another (Bradley 1993; Zhang and Wildemuth 2005).

As Table 1 indicates, barriers are complex phenomena, layered with a variety of multi-directional influences capable of overlapping differently in different contexts. An analysis of the intersections between barriers limiting women's participation in technology entrepreneurship identified new groupings of barriers. These were categorized in a matrix (Table 2) whereby the dimension 'type of barrier' was superimposed over the other two (e.g. overlapping the 'symbolic'/'macro' columns and the 'explicit'/'micro' columns). This resulted in four overall category quadrants, and the variables described as barriers in the literature were tested against each quadrant for fit using the descriptions in Table 2 to organize them into categories.

Organizing the data in this manner provides a more layered and contextualized view of barriers that exist simultaneously and the factors that sustain them, highlighting relationships that are often difficult to see in other ways. One such observation, for example, was that the variables identified as 'barriers' for females in technology entrepreneurship are generally the same as those described as 'resources' in descriptions of successful (male) entrepreneurs in the same context. In other words, when the context stays constant, the most noticeable difference between people with barriers and people with resources is gender. Within the context of technology entrepreneurship, the resources most often noted as barriers for women are access to financial and social capital (Robb, Coleman, and Stangler 2014).

Table 1. Barriers limiting women's participation in technology entrepreneurship by dimensions or themes identified in the research.

Location of barrier	*Internal (individual)*	• Situated within the individual, or focused on individual behaviours, skills, resources, or cognitive processes
	External (context)	• Situated outside of the individual, or focused on resources with access based on how the individual is perceived by others
Level of barrier	*Macro (cultural)*	• More identity and culture-oriented; focused more on informal structures, less visible influences, and access to intangible resources
	Micro (situational)	• More action and practice-oriented; focused more on formal structures, observable factors, and access to concrete resources
Type of barrier	*Symbolic (intangible)*	• Concerns implicit resources embedded in individual and collective sociocultural identities, meanings and values; may be needed to access other, more explicit types of resources
	Explicit (tangible)	• Concerns more recognizable resources that may be available but inaccessible, depending on context or the symbolic resources needed to acquire them

Table 2. Relationships between intersecting barrier dimensions /themes and their descriptions.

		Level		Type	
		Macro	*Micro*	*Symbolic*	*Explicit*
Location	*Internal*	• Individual identity and cognitive processes	• Individual actions and skill acquisition	• Shaped by culture and social influences	• Shaped by choices and access to opportunities
	External	• Social identity and cultural factors	• Formal structures and practices	• Informal processes, expectations or standards	• Related to accessibility or control of tangible assets

Capital as a framework for expanding our understanding of women in technology entrepreneurship

Contexts where the only discernible difference between those with resources and those with barriers is gender (and/or race, or ethnicity, etc.) highlight a gap in our collective understanding. It suggests the presence of less visible, more symbolic types of resources that are as influential to participation in a given context as the more explicit ones. This illustrates the need to investigate beyond the discernible barriers (described in Table 1) and examine underlying sociocultural factors and cognitive processes (like traditional gender roles, cultural influences, gendered and racial divisions of labour and resources, stereotypes, and implicit biases) that shape access to both symbolic and explicit resources and create contextually specific barriers along gender lines (Table 2). To do this requires an expanded framework that captures the research conducted to date while also extending our understanding of the role of context(s) and how it affects access to the resources and forms of capital described as barriers to women in technology entrepreneurship.

In response to these needs, we expand the conceptualization of both *resources* and *capital* beyond their traditional economic meanings and intentionally differentiate between the two in the context of this literature review. We do this to emphasize that (1) there are *explicit resources* (which are more visible and concrete) and *symbolic resources* (which are less visible and more abstract, with value and access determined by social and cultural norms and perceptions), needed by entrepreneurs in order to participate in this context; and (2) the challenges encountered by women in technology entrepreneurship involve both types of resources, meaning that barriers to 'capital' in this context go beyond financial investments or social networks. In this sense, 'capital' is actually a term that encompasses both explicit and symbolic resources (Bourdieu 1986) that impart 'power, status or authority on their holders' (Maton 2004, 37) and exists in multiple forms, including: *human capital* (or skills, experience, education, and time), *social capital* (mentors, networks, and stereotype bias), *financial capital* (access to investment money, risks assessed by lenders), and *cognitive capital* (self-efficacy, motivation, outcome expectations, and interest).

All four forms of capital are necessary for women to participate as technology entrepreneurs, and each becomes a barrier to participation when inaccessible. Therefore, a broader framework is needed to analyse each form of capital as a complex barrier consisting of multiple layers of explicit and symbolic resources. To do this, we use the data from the literature review to develop a *capital framework* (Figure 1) to represent the multi-faceted barriers and intersecting layers of context involved in technology entrepreneurship as it relates to gender. The sections below summarize the findings of the literature review within this framework to provide a more comprehensive view of the barriers at play. We align the research in this way to demonstrate the relevance of each form of capital as well as the interconnectedness of the layered individual, sociocultural, and contextual factors maintaining the token status of women in this field.

Human capital

Human capital in the context of entrepreneurship is best described as the *potential* or *capacity* of an individual to start a venture in any particular area. Comprised of the accumulated education, skills, knowledge, abilities, training, and technical work experiences in an industry or sector, human capital represents the raw individual resources a potential entrepreneur can transfer into an enterprise (Bourdieu 1986; Ezzedeen and Zikic 2012; Gatewood et al. 2003; Klyver and Terjesen 2007; Manolova, Brush, and Edelman 2007; Marlow and McAdam 2013; Robinson and Stubberud 2009; Terjesen 2005; Thebaud 2015b).

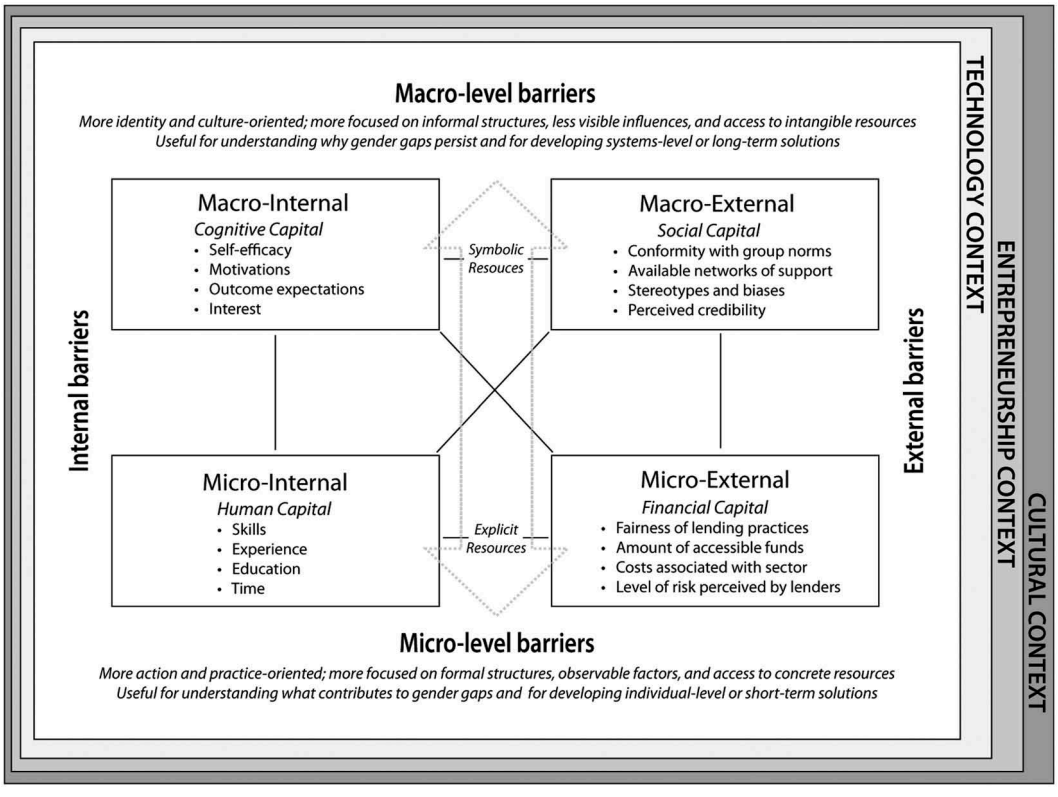

Figure 1. A capital framework of analysis for examining complex gender barriers and access to forms of capital needed to participate in overlapping contexts.

Nature vs. nurture

One of the biggest barriers preventing many women from seeking to develop the skills used by entrepreneurs are biologically based arguments that claim men are more genetically pre-disposed to have the personality characteristics, or 'basic talent', needed for entrepreneurship and new venture creation (Lazear 2004; Obschonka, Silbereisen, and Schmitt-Rodermund 2011, 2012). This reflects 'one of the oldest questions in entrepreneurship research, namely, whether an entrepreneurial mindset is the result of development and experiences or whether it is a talent some people have and others do not' (Stuetzer, Obschonka, and Schmitt-Rodermund 2012, 97). One research study in 2014 reported that entrepreneurship requires 'a special type of individual' with particular, inherent personality traits (Miller 2014, 2). Other scholars report that successful entrepreneurs have higher testosterone levels than non-entrepreneurs (Miller 2014; Mitchell, Randolph-Seng, and Mitchell 2011; Rauch and Frese 2007), and explain that an 'intrinsic barrier [for women becoming entrepreneurs] is the natural female disinclination to rivalry and competition' (Polkowska 2013, 160).

A feminist theoretical perspective suggests that many of the characteristics typically used to explain lower rates of female entrepreneurship – such as risk-aversion (Fox and Xiao 2013; Sugimoto et al. 2015; Tan 2008) – are likely less a consequence of biology and more the result of socialized gender roles (Agnete Alsos, Ljunggren, and Hytti 2013; Blickenstaff 2005; Gatewood et al. 2003; Gundry and Welsch 2001; Jome, Donahue, and Siegel 2006; Sullivan and Meek 2012; Sweida and Reichard 2013). Similarly, research on differences in interest, ability, and performance levels in math, science, and technology between males and females shows these skills to be learned and not innately tied to sex (Dweck 2008; Hill, Corbett, and St. Rose 2010; Yeager and Dweck 2012).

Education

In the midst of debates about whether entrepreneurship is an innately masculine characteristic or a set of skills that anyone can be taught (Henry, Hill, and Leitch 2005a, 2005b, 2005c; Klein and Bullock 2006; Kuratko 2005), it is not surprising that women enroll in entrepreneurship training and education programmes at far lower rates than men (Robb, Coleman, and Stangler 2014; Thebaud 2015a, 2015b). Likewise, the historical associations between normative masculinity and technology (Bury 2011) have resulted in women in the USA being less likely to pursue formal education in fields where the skills often used to start technology ventures are acquired (BarNir 2012; Gill and Ganesh 2007; Hill, Corbett, and St. Rose 2010; Orser, Riding, and Manley 2006; Ranga and Etzkowitz 2010; Williams 2013), and are subsequently less likely to acquire any additional human capital in the form of career experience from working in technological fields later on (Bastedo 2010; Greene et al. 2003; Hill, Corbett, and St. Rose 2010). In other words, a woman is much less likely to become a technology entrepreneur if she is less likely to study technology in the first place (Rosa and Dawson 2006).

However, multiple studies show that among women who have acquired an advanced degree in a technology field, females participate in less technology transfer and research commercialization activities than their male counterparts (Goel, Goktepe-Hulten, and Ram 2014; Rosa and Dawson 2006; Sugimoto et al. 2015). Empirical investigations of gender differences in entrepreneurial intentions among university researchers indicate that academic entrepreneurship is not a gender-neutral phenomenon (Rosa and Dawson 2006). While holding an administrative position plays a strongly positive role in male entrepreneurial propensity, female propensity to commercialize research while holding these positions is strongly negative (Sugimoto et al. 2015). Male technology researchers are more likely to apply for patents and have more favorable attitudes towards commercialization and entrepreneurship activities overall (Goel, Goktepe-Hulten, and Ram 2014; Sugimoto et al. 2015). This willingness to seek out patents has financial implications as well; many investors view patent applications as indicators of project quality (Haussler, Harhoff, and Mueller 2012) and reports state that 76% of venture capitalists consider patents in funding decisions (Graham et al. 2009). However, studies that evaluate patenting as an actual measure of 'innovative output' show that although female scientists participate less in commercialization activities and produce less patents as primary inventors (Delixus Inc 2012; Milli et al. 2016; U.S. Patent and Trademark Office 2016), 'the quality and impact of their patents is equal to or better than that of male scientists' (Whittington and Smith-Doerr 2005, 365; see also Ashcraft and Breitzman 2012).

Work experience

Since both men and women are more likely to establish businesses in sectors with which they have gained some familiarity during employment (Koeber and Wright 2006; Ljunggren and Kolvereid 1996), and there are more than 10 times the number of men-owned as women-owned firms in the science, engineering, and technology sectors (Prowess 2007), many explanations for gender gaps in high-tech entrepreneurship are centred around the lack of female work experience in technology (Greene et al. 2003; Simard et al. 2008). Research shows a negative association between industry experience and enterprise failure rate, as well as a positive relationship between technology-related work experience and venture growth (Colombo and Grilli 2007). Technology-related work experience is also associated with increased contacts within the technology industry and more elaborate networks – the types of vital social capital found to facilitate the creation and growth of new ventures (Thebaud 2015a, 2015b; Tinkler et al. 2015). However, some research indicates that this connection between technology work experience and the intention to pursue technology entrepreneurship may not be the same for everyone. A study by BarNir (2012) found that while industry experience and a background in technology occupations are significant positive predictors for the startup decision for men in IT, they are actually *negative* predictors for women.

Social capital

In addition to human capital, the number and quality of an individual's social connections can also influence intentions to become an entrepreneur and the types of ventures created (Baron 2007). An entrepreneur's social capital is often defined as the benefits that can be extracted from their social structures, networks, and relationships (Baron 2007; Ogzen and Baron 2007). These benefits can either take the form of physical resources (like investors or collaborators), or less tangible assets such as mentorship, support, advice, introductions, and access to valuable information, opportunities, or partnerships (Sappleton 2009; Sullivan and Meek 2012).

Mentors and role models

Evidence regarding the importance of same-gendered mentors is mixed for entrepreneurs, though female entrepreneurs in high-tech industries cited a 'lack of available advisors' (4) to be one of their top challenges in a 2014 survey (Robb, Coleman, and Stangler 2014). Several studies indicate that same-gender mentoring relationships may have some advantages over cross-gender ones (Agnete Alsos, Ljunggren, and Hytti 2013; Ezzedeen and Zikic 2012; Marlow and Mcadam 2015). For example, mentors in same-gender dyads have been reported to provide more psychosocial support (Agnete Alsos, Ljunggren, and Hytti 2013; Lockwood 2006). Gender demographics in both the entrepreneurship and technology fields, however, have resulted in male mentors being more readily available than female mentors (Martin et al. 2015; Polkowska 2013; Ranga 2008; Stephan and Levin 2005). Additionally, cross-gender mentorships may allow women to leverage some of the legitimacy (Godwin, Stevens, and Brenner 2006; Sappleton 2009) and broader network connections that are typically more accessible to males in technology as a result of their gender (Etzkowitz et al. 2000; Ranga and Etzkowitz 2010; Sullivan and Meek 2012). Providing more access to mentors (of any gender) may prove to be an important strategy for encouraging women to start and run successful high-growth companies (Bastedo 2010; Coleman and Robb 2014; Dabic et al. 2012; Kirkwood 2009; Robb, Coleman, and Stangler 2014).

Networks

Research findings on gender differences in networking practices between men and women in technology entrepreneurship show mixed results. It has been suggested that women network and form professional relationships differently than men in business settings (Dabic et al. 2012; Gatewood et al. 2009; Marlow and Carter 2004), and their tendency to primarily befriend other women hinders their advancement in male-dominated fields (BarNir 2012; Lounsbury and Glynn 2001; Navis and Glynn 2011). Studies of academic technology commercialization find that men and women in academia experience different 'network pathways' to the commercial realm – women form concentrated, close ties while men form more diffuse referral networks (Goel, Goktepe-Hulten, and Ram 2014; Polkowska 2013; Sugimoto et al. 2015). Diffuse networks are believed to advantage men in this area because the majority of spinout companies created from the commercialization of academic research are catalyzed by external interest from investors and potential industry partners. Senior academics in technology departments are most likely to be approached by external investors with opportunities for commercialization activities and, proportionally, most senior researchers in these departments are male (Rosa and Dawson 2006).

Other studies have found that although the gender composition of individuals in the networks of male and female entrepreneurs is different, the ways in which they network are not, and gender composition has little bearing on the effectiveness of the network (Baker, Aldrich, and Nina 1997; Tan 2008). Though some researchers suggest that the most successful female entrepreneurs in the technology sector are those who 'accept the established male models of doing business [in order to] gain acceptance and credibility' (Martin et al. 2015, 548), many report that when it comes to the establishment and leveraging of their networks, women and men appear to behave in largely similar ways (Foss 2010; Neergaard, Shaw, and Carter 2005) and have similar network composition and quality (Hampton, Cooper, and McGowan 2009; Rutashobya, Allan, and Nilsson 2009), especially as the venture becomes more established (Hampton, Cooper, and McGowan 2009; Klyver and Terjesen 2007).

Financial capital

Both real and perceived barriers to obtaining financial capital and sustained investor interest are common explanations for the lack of women in technology entrepreneurship (Avnimelech and Teubal 2006; BarNir 2012; Brooks et al. 2014; Brush et al. 2014; Gatewood et al. 2003; Holmquist and Wetter 2010; Klotz et al. 2014; Menzies, Diochon, and Gasse 2004; Tinkler et al. 2015; Zimmerman and Zeitz 2002). Female entrepreneurs are generally perceived as 'riskier' investments than men when it comes to venture financing (Gatewood et al. 2003), although explicit evidence of discriminatory lending practices towards women remains mixed (Coleman and Robb 2014; Kenney and Patton 2015; Marlow and McAdam 2013; Orser, Riding, and Manley 2006). Venture capital, often seen as being critical to growth in technology and innovation sectors, remains 'notoriously difficult for women to access' (Ezzedeen and Zikic 2012, p.46). Female entrepreneurs who believe that they will not get credit often do not even contact a bank or apply for a loan when starting a venture (Holmquist and Wetter 2010).

In addition, research shows that the uncertainty factor that accompanies innovative ventures has a greater negative impact on the ability of female entrepreneurs to receive investment money than it does for males (Orser, Riding, and Manley 2006; Thebaud 2015a, 2015b; Tinkler et al. 2015). Entrepreneurial ventures that pitch new technologies and innovations are considered to be riskier by potential investors than their more traditional counterparts (Thebaud 2015b; Verheul, Uhlaner, and Thurik 2005). Considering this along with the stereotypes about women being less capable in technical areas and implicit expectations that men will be better entrepreneurs, decisions about women seeking financing for innovative technology ventures are coloured by multiple cognitive biases as potential investors calculate risks (Coleman and Robb 2014; Gatewood et al. 2003; Orser, Riding, and Manley 2006).

Overall, it has been found that female entrepreneurs are substantially less likely to receive private investment funding compared to male entrepreneurs with similar levels of experience (Tinkler et al. 2015). The National Center for Women and Information Technology reports that female-owned businesses rely primarily on internal sources of start-up capital, while male-owned businesses have greater access to external sources (Aspray and Cohoon 2006). The ultimate consequences of the gender disparities in access to investment money is that female entrepreneurs are required to start new businesses with lower amounts of start-up capital, are typically unable to create enterprises in fields with higher levels of startup costs, and are unable to match the growth of better-funded firms (Avnimelech and Teubal 2006; Coleman and Robb 2014; Gatewood et al. 2003; Robb and Coleman 2009).

Cognitive capital

The accumulation of cognitive or psychological capital – which can be conceptualized as the desire or intent to participate, self-efficacy, confidence, outcome expectations, and motivation – is shaped by both implicit and explicit factors (Ahl 2002, 2006; Ahl and Nelson 2010; Eagly, Beall, and Sternberg 2004). Many women are currently acting as entrepreneurs, yet they continue to be dismissed by the larger culture as a type of 'peripheral' or 'secondary' entrepreneur (Ahl 2006; Byrne and Fayolle 2010; Mohanty 2003; Perrin Moore 2012). Lower expectations about women's ability as entrepreneurs lead to what the 2012 Global Entrepreneurship Monitor report calls 'covert discriminatory practices' that 'are subtle, and sometimes not even recognized by entrepreneurs, in that they have to do with status expectations or gendered roles. It is expected that men will be venture capitalists or fast growth high-tech entrepreneurs, but less expected that women will be in these roles' (Kelley et al. 2012, 7). Ultimately, actual or perceived career barriers, stereotypes, and beliefs about entrepreneurship are 'shaped by subtle but pervasive cognitive and social input from the environment' (Walton and Banaji 2004, 193) and influence access to opportunity, improved social status, and economic well-being.

Willingness to participate

Much of the research on female entrepreneurship over the past four decades has focused on how they compare to male entrepreneurs (Brush 1992; Greene et al. 2003; Sullivan and Meek 2012), and has often framed females as deficient or 'handicapped' (Bates 2002; Ezzedeen and Zikic 2012; Foss 2010) by various factors as both potential and practicing entrepreneurs (Goss et al. 2011; Karimi et al. 2013; Marlow and McAdam 2013; Mitchelmore and Rowley 2010; Shao-Hui, Ping, and Peng-Peng 2011). Research shows a strong link between women's perceptions about entrepreneurship and their rates of participation as entrepreneurs (GEM 2010; Kelley et al. 2014, 2012). 'Where women believed there were good opportunities for starting businesses, and where they had confidence, ability and spirit for this activity, there were typically higher female entrepreneurship rates' (Kelley et al. 2012, 42). Doubly impacted by the masculine stereotypes surrounding both technology and entrepreneurship, women who do become entrepreneurs are overwhelmingly found in the less-profitable consumer, retail, and service industries, while males continue to dominate the more profitable and faster-growing manufacturing and technology sectors (GEM 2010; Kelley et al. 2012).

Self-efficacy

Gender differences in skill level and confidence are frequently observed in fields stereotypically associated with male characteristics (Chen and Latham 2014; Dohrman 2010; Fox and Xiao 2013; Pathak, Goltz, and Buche 2013; Sappleton 2009; Smith et al. 2013; Smith 2009), and women are more likely than men to limit their career choices in male-dominated fields because they believe they lack the necessary abilities – regardless of their academic achievements in these areas (Bandura 1993; Kay and Shipman 2014; Wilson, Kickul, and Marlino 2007). Actual skill levels appear to matter less than self-perceptions of those skills (Bandura 2001), especially when those self-perceptions are reinforced by gender stereotypes (Wilson, Kickul, and Marlino 2007). Research by Kickul and D'Intino (2005) demonstrates a direct relationship between self-efficacy and entrepreneurial intentions in female students, supporting the need for educational initiatives that address both entrepreneurial knowledge and self-efficacy.

Motivations

Even though motivation is a complex process and notoriously difficult to assess (Bloch 1979; Margison and Brown 2007), the motives for becoming self-employed, starting a new enterprise, or taking a risk on a venture with uncertain outcomes are frequently topics of examination in entrepreneurship research (Barakat, Boddington, and Vyakarnam 2014; Baron 2007; Chandan 2015; Petridou, Sarri, and Kyrgidou 2009). The cognitive processes that form our intentions rarely occur deliberately; instead, motivations are usually developed unconsciously and shaped by a tangle of external influences and internal resources (like past experiences, biases, perceptions, expectations and a variety of other inextricable social, contextual, and cognitive factors) that most individuals never examine or become consciously aware of. Since motivations are abstract and unobservable they are usually assessed using self-reports, although people tend to be more confident than accurate when asked to introspectively determine the reasons for their own behaviours (Gopnik 1993; Johansson et al. 2005; Pronin 2009; Steele, Spencer, and Aronson 2002; Wilson and Bar-Anan 2008) .

In spite of this, opinions are divided about the role that gender plays in shaping motivations for becoming an entrepreneur, as well as the outcomes or goals entrepreneurship is intended to achieve (Heydari, Madani, and Rostami 2013; Mitchelmore and Rowley 2010; Orser and Hogarth-Scott 2009; Rindova, Barry, and Ketchen 2009). While venture creation in the technology sector and high-growth enterprises are commonly described as *opportunity-motivated* entrepreneurship, *necessity-driven* motivations for entrepreneurship are often associated with smaller, less growth-oriented enterprises (Avnimelech and Teubal 2006; Loscocco and Bird 2012; Moore and Buttner 1997; Morris et al. 2006) that are less attractive to investors (Gatewood et al. 2003; Sappleton 2009; Zimmerman and Zeitz 2002) and must be started with less capital (Brush et al. 2014; Orser, Riding,

and Manley 2006) – all of which increases their vulnerability to the economic risks associated with entrepreneurship and decreases their likelihood of success (Mcgrath 1999; Watson 2003).

Female entrepreneurs are more likely than their male counterparts to be found in ventures associated with necessity-driven entrepreneurship (Brush et al. 2014; DeTienne and Chandler 2007; Fletcher 2006; Gedeon 2010; Kelley et al. 2014; Zeyen et al. 2012). However, it is likely that assessments of motivation tell us more about cultural expectations and the unconscious biases that shape intentions than they do about actual motivation (Margison and Brown 2007). This may account for newer research demonstrating that entrepreneurial motives for men and women are the same much more often than they are different (Thebaud 2015a), and that the differences that get emphasized are likely far better reflections of gendered access to resources and how society frames the work done by women than they are of actual motivational dissimilarities (Green and Cohen 1995; Hughes 2003; Jennings and Brush 2013; Loscocco and Bird 2012; Mattis 2004; Moore and Buttner 1997; Reynolds and Renzulli 2005).

Contrary to what is portrayed about entrepreneurs in the media, entrepreneurship is far more likely to be prompted by economic necessity than by opportunities to get rich quick or commercialize a new idea – for both men and women (GEM 2010; Rindova, Barry, and Ketchen 2009; Scott and Vincent-Lancrin 2014). Yet in cultures with social norms that define certain responsibilities as more feminine or more masculine than others, inequalities in the amount of time these tasks require and the resources received in return can divide access to need- and opportunity-driven pursuits by gender (Jacobs and Gerson 2004; Thebaud 2015a). Females are also more likely than their male partners to be faced with balancing outside work requirements with a full load of domestic and family obligations, but the ventures they start are not likely to be depicted as opportunity-motivated ways to overcome these challenges or even as entrepreneurship at all; instead, working from home and business ownership are often framed simply as female 'coping strategies' (Aaltio and Wang 2015; Dohrman 2010; Marlow 1997) for women who want more flexibility in how they manage the competing demands on their time (Alonso-Galicia et al. 2015; Ben 2007; Brush 1992; Ranga and Etzkowitz 2010).

Discussion and implications for future research

Despite the persistent notion of entrepreneurship as a meritocratic and equally accessible field of gender-neutral opportunities, research conducted to date suggests otherwise. The masculinity embedded in the concept of entrepreneurship, historically and culturally, have made it difficult for women to symbolically and logistically claim the position of 'entrepreneur' (Ahl 2006; Ahl and Nelson 2010; Calas, Smircich, and Bourne 2009; Marlow and Mcadam 2015; Watson and Newby 2005), and this is particularly true when situated within the context of technology (Fisher 2010; Lounsbury and Glynn 2001; Marlow and McAdam 2013; Navis and Glynn 2011; Zimmerman and Zeitz 2002). As seen in efforts to encourage more women to participate in STEM fields, gender gaps are systemic and influenced in numerous ways by culture, cognition, choices and contexts (Hill, Corbett, and St. Rose 2010). These become increasingly complex where identities and contexts overlap, and where access to explicit and symbolic resources is tied implicitly to category expectations, social roles and perceptions about fit or belonging (Nina Gunnerud 1997; Symington 2004).

A review of the individual and contextual factors maintaining the token status of women in technology entrepreneurship indicates the need to consider broader frameworks to understand the barriers associated with access and participation. Access to financial and social capital are insufficient for explaining these barriers. If research and practice continues to focus primarily on resources women lack, and the improvement of 'female deficits', it may be inadequate for driving significant increases in participation and retention.

Other forms of 'capital', including cognitive attributes and human capital, provide a useful framework for broadening our research and programming around inclusivity in entrepreneurship and technology. Framing capital more broadly allows us to extend beyond the explicit resources

required to examine sociocultural factors and cognitive processes as embedded symbolic resources. Further, it allows us to examine how these are contextually determined. Interestingly, these forms are capital are fairly well-studied in the more general research on entrepreneurs, particularly in relation to entrepreneurship education, but appear to take a secondary role in discussions around women's involvement in technology entrepreneurship. Changing the status of women from token players to full participants in technology entrepreneurship requires examining layers of overlapping barriers on multiple fronts and shifting our approaches to research and practice to create more context-specific solutions.

Yet there are significant challenges associated with moving in this direction, which may explain the limited literature in this field. Small and dispersed populations impede efforts to conduct new streams of empirical research and generalizable recommendations. The research required to understand systemic issues, as described in this article, is complex. Variables are influenced by multiple individual and environmental factors, many of which cannot be manipulated in research settings, and may not even be recognized by scholars without interdisciplinary training. These factors encompass early socialization, culture, educational experiences, and access to/acquisition of both entrepreneurship and technology skills, not to mention the influence of society, culture, and understanding of how cognitive biases are formed and interrupted.

As an example, this synthesis of research represents the tradeoffs between depth and breadth of analyses that result from resource constraints (e.g. time, funding, faculty expertise), as well as contextual boundaries (e.g. geographic focus, cultural barriers, language). It was challenging to extend the scope beyond simply 'women' in technology entrepreneurship to include an examination of differences in female participation rates across the many industry sectors that encompass 'technology'. Further, it was not logistically possible to address how each additional intersection (such as race, class and gender) may impose new barriers. Every additional intersection means there are less participants available to study. The inability to 1) adequately address specific barriers and intersections beyond gender, technology, and entrepreneurship, and 2) avoid using 'women' as an oversimplified social category, were noticeable tradeoffs made in order to compile enough articles for a comprehensive review of the literature.

It is quite possible that the best way to overcome these challenges is to change tactics. As a discipline, we need to shift from a 'fixed-mindset' of inherent, between-sex differences and gendered personality traits to a 'growth-mindset' (Dweck 1999) that emphasizes learnable skills that differ according to context, not gender. As researchers, we need to shift our methods to include more multi-level analyses that explore how social practices and cultural discourses shape access to both explicit and symbolic resources and contribute to the underrepresentation of skilled and innovative women. This means research approaches may need to shift from sampling convenient but homogenous populations because they are large enough to study, to doing more in-depth examinations of marginalized populations to understand how to decrease barriers, and subsequently increase participation enough for more generalizable studies. The objectives of these studies must also shift from the development of short-term strategies to help women overcome existing barriers to longer-term approaches that focus on discovering how to prevent gendered barriers from being created in the first place.

This may require scholars who are willing to apply more macro-level sociocultural methods traditionally found outside of the discipline – such as discourse analysis, media content studies, and rhetorical framing analysis – to entrepreneurship research. This would require that academic departments shift their faculty selection criteria to cultivate and/or value more disciplinary diversity, and that these types of research methods be acceptable for inclusion in top business and entrepreneurship journals. Most importantly, new approaches to research in this area must be recognized with research funding and be valued in promotion and tenure decisions. Finally, when it comes to the assessment of programmes and policies already in place to enhance the participation rates of women in both entrepreneurship and technology, such as female startup incubators, we should consider including broader frameworks such as those presented in this manuscript, as opposed to measurements based on stereotypical forms of masculinity as embedded yardsticks of success.

Conclusion

Involvement in and attention to gender within the fields of entrepreneurship and technology have increased over the years, yet are viewed by many as being insufficient given shifts in demographic, economic and workforce trends. This manuscript provides the most current review of the literature on gender and technology entrepreneurship, underscoring the token-nature of women in the research and practice associated with the field. The proposed framework extends the concept of the 'capital' required for participation technology entrepreneurship beyond that of financial investment and social networks, to human capital and cognitive capital, thereby providing a more comprehensive and descriptive approach to measure the influence of embedded individual and contextual factors influencing intent, outcome, and participation. This approach responds to the need for more integrated, multilevel analytical frameworks in the research on women in technology entrepreneurship.

Note

1. There is a general lack of disciplinary consensus about what types of ventures specifically qualify as 'technology entrepreneurship'. We operationally defined both 'entrepreneurship' and 'technology' in this context somewhat broadly to encompass many of the diverse terms that frequently appear with them in the literature.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

Summary of women and technology entrepreneurship articles

Citation/Journal	Independent variables (IV)	-Dependent variable(s) (DV)	Population sample	Theory	Methods	Key findings
Cohoon and Mcgrath (2011) *Open Source Business Resource (OSBR) (now Technology Innovation Management Review (TIM Review))*	Gender	Highest degree earned; interest in becoming an entrepreneur; family educational and entrepreneurial history; motivations for starting business(es); sources of funding; importance of various factors for startup success; challenges faced, professional networks	Founders of high-tech enterprises	None stated	Email surveys (n = 542; 41 female/501 male)	When the gender distribution of a trait was similar in both groups, it was not likely to be a cause of women's underrepresentation among successful high-tech entrepreneurs. Motivation by desire for wealth, importance of knowledge gained from experience, and access to social networks including mentors and advisors could all contribute to the gender imbalance among successful high-tech entrepreneurs
Dautzenberg (2012) *International Journal of Gender and Entrepreneurship*	Gender of founder (m/f/ mixed teams)	Firm size; number of employees; revenue	German technology firms	Social constructivism	Secondary data analysis (n = 6301 firms); comparison of temporal cohorts using binary logistic regression	While firm characteristics such as firm size, number of employees, and revenues are correlated to gender, firm success appears to be independent of these
Dohrman (2010) *Dissertation*	Gender; age	Perceptions of entrepreneurship/ entrepreneurial work	Young high-tech entrepreneurs (mostly students)	Social constructionism; Discourse theory; Organizational communication theory	Discourse analysis of mainstream media; thematic analyses of interviews with young entrepreneurs (n = 50) and focus groups with members of the Millennial Generation (n = 57); secondary data analysis of the Global Entrepreneurship Monitor (GEM) data	Offers collective sense-making as an complement to the individual traits-based model of understanding entrepreneurial work: perceived meaningfulness of one's work may lessen the negative impacts of the enterprising self and ideal worker ideologies

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Citation/Journal	Independent variables (IV)	-Dependent variable(s) (DV)	Population sample	Theory	Methods	Key findings
Ezzedeen and Zikic (2012) *International Journal of Gender and Entrepreneurship*	Gender	Experiences of entrepreneurship within the technology field	Canadian female high-tech entrepreneurs	Role congruity theory	Interpretive phenomenological approach; in-depth interviews (n = 12)	Subjects encountered persistent gender stereotypes, a lack of female role models, resistance from associates within and outside of their organizations, and societal pressures to maintain appropriate levels of work-family balance
Gicheva, Dora; Link, Albert N. (2015) *Small Business Economics*	Gender of firm owner	Relative probability of attracting private investments to fund commercialization of technology to market	Participants in NIH small business programme (tech sector)	Network theory	Survey responses (n = 323)	Women-owned firms are much less likely to attract private investment dollars compared to male-owned firms; women-owned firms that received larger awards performed substantially better
Hampton, McGowan, and Cooper (2011) *International Journal of Entrepreneurial Behaviour & Research*	Gender of entrepreneur	Network type and composition; nature and frequency of engagement; changes in network composition and networking activities through the business lifecycle	Female entrepreneurs operating STEM-based ventures in Northern Ireland	None stated	In-depth interviews (n = 18)	Women and men behave in largely similar ways in the establishment and utilization of their networks, and have similar network composition and quality, especially as the venture becomes more established
Martin and Wright (2005) *International Journal of Entrepreneurial Behaviour & Research*	Personal background and motivation; personal contacts; networking practices	Access to resources; firm outcomes	Owners and other staff in tech companies run by female entrepreneurs	None stated	Semi-structured interviews (n = 10 firms) and thematic grid analysis to form a major part of text analysis	The types of companies set up and the way in which they were run inevitably relates to the gender of the entrepreneur, where deliberate choices have to be made to combine home and work needs

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Citation/Journal	Independent variables (IV)	-Dependent variable(s) (DV)	Population sample	Theory	Methods	Key findings
Martin et al. (2015) *International Journal of Entrepreneurial Behavior & Research*	Perceptions and experiences of the STEM context for female entrepreneurs; experiences of business start-up	Strategies for managing gender-based discrimination	Female STEM entrepreneurs with businesses that had progressed beyond the initial start-up phase	Identity construction theory	Semi-structured interviews (n = 15) and documentary records analysis using both manual and software-based thematic review	Taking a longitudinal approach which covers different stages in the development of the firm, might show how women engage with STEM start-up, growth and exit to help policymakers provide the right kind of support environments to female entrepreneurs at different stages of their business development
Mayer and Heike (2008) Regional Studies	Gender of entrepreneur; geographic location; prior experience & education	Type of venture/industry sector; firm longevity & performance	Records for women-owned high-tech firms in four regions (Silicon Valley, Boston, Washington, DC, Portland)	Labour market segmentation theories (including neoclassical, institutional and feminist frameworks)	Secondary data analysis (n = 11,772 records) using ANOVA	Although women are entering non-traditional sectors, female entrepreneurs tend to own businesses in female-typed high-tech sectors (management consulting services, computer systems design services, software and Internet/telecommunication services). Female-typed high-tech firms have on average fewer employees, smaller sales volume and are younger than their male-typed counterparts. Male-typed and female-typed women-owned high-tech firms differ significantly in terms of sectoral and spatial segmentation regardless of firm age
McQuaid, Smith-Doerr, and Monti (2010) *American Behavioral Scientist*	Founder gender; countries of origin	Firm revenue; industry specialty area	Biotech firms located in Massachusetts and New England	Social capital theory	Survey (n = 261 firms)	Female life scientists are underrepresented in founding roles in biotech firms; immigrant men have better success in entrepreneurship than do female scientists

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Citation/Journal	Independent variables (IV)	-Dependent variable(s) (DV)	Population sample	Theory	Methods	Key findings
Orser, Barbara; Riding, Allan; Stanley, Joanne (2012) *Entrepreneurship & Regional Development*	Gender of entrepreneur	Sector; perceived barriers to career advancement in technology; challenge resolution strategies	Entrepreneur members of Canadian Women in Technology	Gender schema theory	Analysis of qualitative data from an online survey using Nvivo	Respondents attributed a high proportion of the challenges they encountered to gender; respondents were most likely to resolve challenges through personal solutions with few firm or industry-related support structures cited; lack of mentorship opportunities is particularly acute for women entrepreneurs
Robb and Coleman (2009) *Kauffman Foundation Report*	Gender of entrepreneur	Sources of financing for new tech firms	New businesses in the USA, partitioned into sampling strata defined by industrial technology categories	Life cycle of ventures theory	Longitudinal survey	Women entrepreneurs raised significantly smaller amounts of financial capital at startup than men did; women high-tech entrepreneurs were significantly less likely to use external equity
Sappleton (2009) *International Journal of Gender and Entrepreneurship*	Business owner gender; firm sector	Level of social capital	Male and female business owners in Europe	Gender stereotypes theory; social networks theory	Secondary data analysis of subsets of the 2006 European Social Survey (ESS); regression analysis of four sub-samples: females in female-dominated industries (n = 283); females in male-dominated industries (n = 337); males in male-dominated industries (n = 1476) and males in female-dominated industries (n = 118)	Women who operate firms in traditionally female sectors are found to have the highest levels of social capital. Men and women working in traditionally male sectors exhibit lower levels of social capital, measured in terms of trust, community engagement and social networks. Self-employment in a gender traditional or non-traditional sector is found to be a significant predictor of social capital

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Citation/Journal	Independent variables (IV)	-Dependent variable(s) (DV)	Population sample	Theory	Methods	Key findings
Sweida and Reichard (2013) *Journal of Small Business and Enterprise Development*	Conceptual paper	Conceptual paper	N/A	Stereotype activation theory	N/A	By decreasing the masculine stereotype-related barriers associated with high-growth entrepreneurship and increasing women's HGE self-efficacy it should be possible to increase women's intention to engage in high-growth venture creation
Tan (2008) *Journal of Business Ethics*	Gender of entrepreneur	Entrepreneurial intention; venture performance	Male and female entrepreneurs in the Chinese tech sector	Institutional theory; entrepreneurial orientation theory	Survey (n = 43; 18 female) with ANOVA; Randomly selected interviews for triangulation	Women entrepreneurs can be driven by opportunities rather just necessity. This is a departure from findings from a large scale global study of entrepreneurs from 27 countries, which reports that men are more likely than women to pursue opportunity entrepreneurship, while women are more likely to pursue necessity entrepreneurship
Thebaud (2015a) *Social Forces*	Gender of the entrepreneur; innovativeness of the business plan	Perceived competence of entrepreneur, how skilled they were, and how committed they were to the venture; perceived quality of the business proposal and likelihood of participant investing in it	University students in the UK and the USA	Social psychology of gender; gender status beliefs theory	Three experimental studies using 2 × 2 mixed factorial design. Study 1 evaluated the effects of gender status beliefs and innovation in a UK setting. Study 2 evaluated these effects in a US setting for a cross-cultural comparison to Study 1. Study 3 evaluated these effects in a high-tech industry setting in the US to provide a comparison to Study 2 (total participants n = 178; 86 males/92 females; n = 21–41 per condition)	Gender status beliefs disadvantage women entrepreneurs when compared to their male counterparts, but innovation in a business model has a stronger and more positive impact on ratings of women's entrepreneurial ability and overall support for their business ideas than it does for men's. However, the strength of these patterns varies significantly depending on the societal and industry context of the new venture in question

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Citation/Journal	Independent variables (IV)	-Dependent variable(s) (DV)	Population sample	Theory	Methods	Key findings
Thebaud (2015b) *Administrative Science Quarterly*	Institutional work–family practices; gender; industry sector	Business start-up and ownership rates	Male and female business owners from 24 countries over the span of eight years	Institutional theory of gender inequalities in business start-up, ownership, and growth orientation	Multilevel secondary analyses of GEM survey data	Institutionally embedded incentives that lead people towards entrepreneurship may operate quite differently for different groups of people, namely men and women; women's disadvantages in entrepreneurship are deeply rooted in the organizational structures, norms, and practices that tend to disadvantage them in wage and salary jobs
Tinkler et al. (2015) *Social Science Research*	Gender of entrepreneur; technical background of entrepreneur (history major with no software engineering work experience/computer science major with some software engineering experience); closeness of social tie between entrepreneur and VC	Evaluation of entrepreneur's leadership capability, competence, and sociability; evaluation about venture's potential for success, uniqueness, and amount they would be willing to invest; importance of perceived level of social capital on decision-making	Male MBA students from the Stanford Graduate School of Business Entrepreneur Club	Status characteristics theory and its applications to gender	Online survey design: study participants (n = 114) evaluated an executive summary of a business plan	The gender of the entrepreneur influences evaluations most when the person, rather than the venture, is the target of evaluation. Technical background qualifications moderate the influence of gendered expectations, and women receive more of a payoff than men from having a close contact to the evaluating VC