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Career change or career progression? Motivations of women studying computing as adult learners

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ABSTRACT

The proportion of female students qualifying in computing and IT degrees in the UK has decreased over the past five years, and is one of the lowest in Europe. While most research on underrepresentation focuses on school age girls and young women entering higher education, there is little written about adult women learners and their motivation for entry into IT work. Adult learners are a compelling sample because they illustrate that studies of gender and careers can benefit from a life-course perspective. In addition, studying adult learners can add to intersectional understandings of underrepresentation by bringing in age/life-stage as a variable in the same way as considerations of ethnicity/race have enriched previous understandings. This paper addresses this gap using a mixed methods study of adult learners pursuing computing degrees part-time through distance learning at one UK institution. The study included an online survey of 253 students, as well as focus groups with women students. While women were underrepresented across the two main degree programmes included in the study, the proportion of women was higher on qualifications where computing was studied along with other subjects rather than computing on its own. The survey showed other gender differences - a higher proportion of men were already working in the IT industry, whereas more women were looking to enter into an IT related role for the first time. The women were also more likely to be career changers - more women than men had a previous STEM-related degree. Nevertheless, some women expressed confidence issues, in particular about entering into careers in the industry rather than their ability to study IT. This suggests that employability in computing, even among women who have successfully completed STEM degrees in the past, or are already working, continues to be influenced by gendered structural barriers and behaviours.

KEYWORDS: adult learners; computing and IT; motivation; gender; degree choice

Career change or career progression? Motivations of women studying computing as adult learners

INTRODUCTION

The UK is facing a significant skills shortage in Information Technology (IT). According to a recent government report, 72% of large companies and 49% of small and medium enterprises are reporting digital skills gaps, and in particular areas of strategic importance, including cyber security, big data, the Internet of Things, apps, mobile and e-commerce (ECORYS UK, 2016). There is already a substantial body of research about the gender gap in STEM education (Kanny, Sax & Riggers-Piehl, 2014) and more specifically in computing and IT (Adya & Kaiser, 2005; Ahuja, 2002; Main & Schimpf, 2017). Much of this research has focused on the motivations and subject choices made by girls in secondary/high school. Many interventions to tackle underrepresentation have also been aimed at this age group. However, the life experiences, situations, and perspectives of adult learners mean that their motivations and choices are likely to differ from the school and university/college studies that predominate in this field.

The contribution of adult and mature learners is increasingly important in filling fast growing skills shortages in IT employment. Even if successful in overturning current trends, efforts concentrated on increasing the numbers of girls and young women undertaking computer science at school and university will take many years to convert into skilled and qualified professionals, whereas adult returners or career changers already have significant transferable skills to bring to the workplace. Moreover, adult women are arguably not under the same peer pressures or parental influence as younger women and girls. Indeed, evidence shows that many women already enter IT from other fields following qualifications and previous careers in other sectors. Female IT specialists are nearly three times less likely than men to hold an IT degree (5% compared with 14%) according to the British Computer Society (BCS, 2019).

Despite this, there is very little empirical research on adult women learners and their motivation for entry into IT work apart from a few studies that focus on returners from career breaks (Herman & Webster, 2010; Panteli, 2006; Castaño & Webster 2011). This paper works towards addressing this gap using a study of adult women undertaking computing degrees at the UK Open University (OU), where the majority of students are over 21, and studying part-time through distance learning. The University has historically presented a 'second chance' to study for those unable to undertake degrees after leaving school – either due to lack of entry qualifications (A Levels) or social/economic pressures to go straight into the workforce or family care. Since the 1970s, the OU's role in empowering women through a return to education and career change has been well known and highly regarded throughout the UK and beyond (Kirkup et al., 2015).

Literature Review

The participation rates of women in IT and computing vary across cultures and locations (Frieze & Quesenberry, 2019). Thus, underrepresentation must be

considered in context, taking account of the particular cultural, social, and economic environment. Evidence from countries like India and Malaysia, for example, show much higher participation rates for women than the US and Western Europe, and indeed a very different perception of the gender-technology relationship (Thakkar et al., 2018; Mellström, 2009; Sondhi et al., 2019). The UK follows a similar pattern to many other countries in Europe and North America in the underrepresentation of women in computing education.

In the UK, female applicants to computer science degree programmes have been declining in comparison to male prospective students for the past ten years (BCS, 2016; Kirkup et al., 2010). Indeed, computer science is the most gender-segregated subject at higher education level with only 15% of total applicants being female. The proportion of women qualifying with computing and IT degrees has also fallen by 10% over 5 years (BCS, 2016). The figures around transition to employment are also not encouraging: six months after graduation, 63% of male graduates but only 47% of female IT graduates were working in a computing or IT role (BCS, 2016).

A frequently used metaphor in 'women in computing' research and policy depicts the problem as one of a leaky pipeline that assumes a linear educational and career trajectory, following the traditional model of more established scientific and engineering professions. However this viewpoint fails to reflect the more complex and varied career structures in computing, including multiple educational pathways into such careers (Vitores & Gil-Juárez, 2016). Moreover, the patterns of underrepresentation do not support such a simple 'leaky pipeline' explanation. For example, the decline in the proportion of women in both computing employment and computing education began to occur at a similar historical time, so the relationship is unlikely to be causal. Rather, these changes are more likely to be a result of an increase in the attraction of men to computing rather than loss of women, whose actual employment numbers have remained fairly static over time (Cohoon, 2011). Moreover, it is clear that the absence of women has not always been a feature of this sector, with higher proportions of women involved in the early days of computing, when 'computers' – the original name for computer operators - were categorised as a feminised occupation (Hicks, 2017). One explanation for the change in gender of computing as a profession was the advent of a culture of 'rugged individualism' that was adopted by the emerging IT industries in the 60s and 70s. Targeted recruitment of a narrow group of white male young men into the profession resulted in the rise of the 'geek' and 'nerd' stereotypes that became embedded in the IT work culture (Ensinger, 2015).

This cultural identification of computing as masculine is still an important factor in subject choice among adolescents at secondary or high school, shaping later career opportunities. Numerous studies have focused on motivation and choice at secondary or high school level offering a range of explanations for the lower uptake of STEM by girls when faced with subject choice (Wang & Degol, 2013). Parents and teachers are seen as significant influencers on students' choice to pursue science (Moeller et al., 2015; Taskinen, Deitrich & Kracke, 2015; Archer, Dewitt, & Osborne, 2015). Confidence in ability can also be influenced by stereotype threat

which in turn leads to girls' reduced levels of success in subjects where they perceive gender differences in performance are expected (Blickenstaff, 2005; Cadaret, Hartung, Subich, & Weigold, 2017). This lower expectation of success among female students can then lead to a reduced personal interest in pursuing advanced studies (Appianing & Van Eck, 2015). We also know that role models can influence school subject choice of adolescents and many interventions have been focused on changing the image of who works in STEM (Jensen and Bøe, 2013; Herman et al., 2019). As Robnett (2013) suggests, differences emerge at various stages of the educational journey, with peers as mediators having different levels of influence at each stage. While fellow students are important mediators for undergraduates and even graduate students at conventional universities, it is likely that these may differ for mature students who are approaching learning as adults.

One area of research has focused on confidence in ability to study IT and computing, with various studies focused on gender differences in computer anxiety – "feelings of discomfort, stress or anxiety that people experience when responding to computers" (Cooper and Weaver 2003 p13). A number of studies have used the Computer Anxiety Scale (CAS) to measure and explain gender differences in uptake of computing education (Arigbabu, 2009; McIlroy et al., 2001). Other studies have found a confidence gap among female students and a "positivity bias," or over-confidence in ability relative to performance, by their male peers (Sobel, Gilmartin & Sankar, 2016). Among adult learners in a Swedish study, women showed significantly lower confidence in their feeling of expertise and ability to pursue a computing professional career (Salminen-Karlsson, 2010). A large body of work has also built on the work of Eccles Expectancy-Value theory examining the relationship between confidence or self-efficacy and the perceived utility or value of undertaking such studies (Wegemer & Eccles, 2019). In other words, motivation is not usually a single factor but more often a balance between several complementary or indeed competing factors.

Castaño and Webster's (2011) exploration of a 'life-course' model points to the need to examine motivation and choice in the context of the wider factors that influence women's career patterns at different stages of their lives. A life-course approach takes into account that the capacity to access jobs, careers and other opportunities are constrained at different transition points (Tomlinson, Baird, Berg & Cooper,2018). Career progression and advancement (especially in STEM occupations) are closely tied with performance criteria that are premised on the traditional male breadwinner with one continuous career, while women's careers are seen as broken or 'frayed' (Sabelis & Schilling, 2013;). Flexibility of career may be a personal choice, for instance for those adopting boundary-less or protean careers that span many organisations and roles (Sullivan & Arthur, 2006; Hall, 2004). This focus on choice assumes a level of personal and individual agency, however, and ignores the structural constraints that influence the careers of many women.

Women's flexible work patterns are often a barrier to progression - they are more likely to move in and out of employment, with periods of family or other care commitments and to work reduced hours for periods of time. Thus, for example

over 80% of the UK's part time workers are women (Tomlinson, Olson & Purdam, 2009). STEM qualified women seeking to return from career breaks find themselves at a particular disadvantage – over two thirds do not return to STEM employment (People Science and Policy, 2002), while many experience 'occupational downgrading' and return to lower paid and lower skilled jobs (Connolly & Gregory, 2008). Among those that do return, many undertake retraining into different STEM fields (Herman, 2015; Herman et al., 2019). Taking a life-course perspective also enables us to understand the intersection of age with gender as a factor in women's disadvantage in the tech sector, and to make visible the impact on career progression of combining work with family care.

Studies have shown that female students' interest in computing is often less 'single minded' and instead more contextual than their male counterparts (Cuny & Aspray, 2002; Margolis & Fisher 2002). This has been an important factor in intervention programmes at US universities, where students are generally not required to choose a 'major' subject until part way through their undergraduate studies (Frieze & Quesenberry, 2015). This differs from countries such as the UK where degrees are specified on entry, and therefore the labelling of named degree programmes may have an impact on gender balance of students enrolling, especially in the case of computing related subjects.

Although there is significant research about gender and motivation of adolescents and young people to study STEM, there is very little literature on gender difference in adult learners' motivation to study IT and computing. We know that women are more likely to express communal goals in their study motivation (Brinkman & Diekman, 2016; Wegemer & Eccles, 2019). Moreover the socio-economic backgrounds of distance education mature learners are likely to be strongly related to their career and employability goals (Delaney & Farren, 2016). In order to address this paucity of research on women adult learners in computing, we developed a study to examine the motivations and choices of women entering distance learning computing and IT programmes and in particular to focus on three intersecting questions:

*Are female adult learners more **attracted** to computing when it is studied alongside another subject rather than on its own?*

*Are there gender differences among adult learners in **motivation** for studying IT and computing?*

*Are there gender difference in adult learners' **confidence** in their ability to study IT and computing?*

CONTEXT

This study is based at a distance education university in the UK where 92% of students are over 21 when they begin their studies, the vast majority studying part-time whilst already in employment. A key study motivation for most students is to change or advance their career.

The Computing and IT undergraduate programme is one of the largest in the university with over 10,000 students registered across its modules. The two main qualifications that are offered are:

- The single honours BSc (Hons) Computing & IT (known by qualification code Q62)
- The joint honours BSc (Hons) Computing & IT and a second subject (with a choice of Business; Design; Mathematics; Psychology; or Statistics) (known by qualification code Q67)

Participants in the study were students who had completed a Level 1 undergraduate module "My Digital Life", (course code TU100) which was a compulsory entry level module for these two qualifications (this module has since been replaced). In addition, the module could also be taken as part of the Open Degree, (where students are free to select their own combination of modules from any discipline), and some other non-degree qualifications.

Our study was part of a wider investigation about gendered study patterns and attainment in the computing and communications curriculum area.

METHODS

Our preliminary task, setting the baseline data for the study, was an analysis of existing student enrolment data to identify gender differences and patterns of study across the two qualifications (Q62 the single honours and Q67 the joint honours). The numbers of men and women enrolled on these two qualifications are given in Table 1.

Table 1*: Enrolments on the single honours (Q62 Computing and IT) and joint honours (Q67 Computing and IT and a second subject) by gender 2017 and 2018*

		2017		**2018**	
		Men	**Women**	**Men**	**Women**
Q62	N=	957	195	831	159
	%	83	17	84	16
Q67	N=	579	617	249	133
	%	67	33	65	35

In the light of these gender disparities between the two degrees, we designed a more structured investigation using a mixed methods approach.

Student consultation

An initial consultation was held with students in order to inform the survey content and design. Our inclusion of students at this stage was intentional to ensure 'student voice' in formulating the direction of the study. An invitation was posted on the main student online forum, and although there was considerable interest expressed, only two women students actually participated in the session. The discussion, which was held online using Adobe Connect, explored motivations for enrolling on their chosen degree programme, experiences of technology work and any gender discrimination they had encountered, and their expected outcomes from their studies. These responses helped to shape the survey questions.

Survey

An online survey was designed by the research team and tested and evaluated by the Open University survey panel. There were ten questions in the survey (see Appendix 1) as well as several opportunities for open text comments. An invitation to the survey was emailed to 1250 students who had completed the Level 1 introductory module 'My Digital Life' (TU100). The survey was open for participation for a period of four weeks. A total of 253 students responded (168 women and 85 men), giving a 20.2% response rate. 66% of respondents were women, compared to the 19% average figure for women taking the TU100 module; thus women were over-represented in the sample. This was not unexpected as the survey was described in the invitation as being an investigation related to gender equality. The majority of the respondents (60%, n=152) were aged between 26 and 45, with 23% (n=59) under 25 and 16% (n=42) aged 46 and over. 87% of the survey respondents identified as White and 10% (n=25) as Black, Asian, Mixed or Other (BAME). The remaining 3% were non-disclosed. Among BAME respondents, 72% (n=18) were women and 18% were men (n=7).

Focus Group

All online survey participants were asked to indicate whether they were willing to be contacted for further discussion and if so to give contact details. Following the closure of the survey, all female students who had indicated their consent were invited via email to participate in an online focus group. Thus, the focus group membership was self-selecting – we initially recruited 12 women but only six students ended up being able to participate. Nevertheless the group was representative of the different types of degree programmes which was one of the key areas of investigation - three were studying the single honours programme Q62; three were studying the joint honours programme - Computing and IT and Psychology (one student), and Computing and IT and Business (two students). The one-hour evening online session was held using the Adobe Connect web conferencing system and facilitated by two members of the research team.

Following protocol on focus group design (Krueger, 2014), we developed prompts for discussion – as this was an online group, these were shown as prompts on screen as the discussion progressed. With the participants' permission, the focus group comments were recorded and transcribed. The team then carried out a thematic analysis of this transcript, together with the survey open text comments.

Initial coding was carried out using NVivo by one team member, using an open-coding approach, and a further round of coding carried out by a second team member, using axial coding to identify connections between codes and ensure inter-coder reliability (Campbell et al., 2013; Mounter & Vonk Noordegraaf, 2012). Themes emerging from this were then discussed and analysed by the whole team.

RESULTS

Our analyses of quantitative data were combined with insights from open comments and focus groups to enable us to explore the sense and meaning of gendered decision making with regard to degree choices. The integration of qualitative methods enabled us to interpret and access women's career and study motivations in the context of their lives that would otherwise have been invisible.

Gendered degree choice

The survey respondents were studying towards several qualifications, but the two most common were the single honours in Computing & IT (n=125, 66 women, 59 men) and the joint honours (n=45, 38 women, 7 men). In addition, 25 students were registered for the BA/BSc Open Degree and the remainder were either studying other diplomas and certificates, did not have a study intention beyond the module itself, or did not provide the information.

Although the single honours degree was the most common study intention of survey participants, the proportions varied significantly between genders. 69% of the men were studying towards this degree compared to 39% of the women. This pattern was reversed for the joint honours degree. Nearly a quarter (23%) of the women stated this as their study intention compared to just over 8% of men. Women were also twice as likely as men to be studying for the Open Degree.

Degree choice was related to career intention

The most popular reason for choosing their degree programme among both men and women was that the degree related to their interest in a career in IT (see Fig 1). However, equal to this for women was that they felt it would give them more confidence in IT. A significantly lower proportion of men strongly agreed with this statement – which also resulted in the biggest difference between men and women across all statements.

Career change was a strong motivation for both women and men, with up to three quarters agreeing (rated 4 and 5) with the statement that the degree would help them 'change' career direction. Women were slightly more likely than men to agree that the degree would help them 'progress' in their current career.

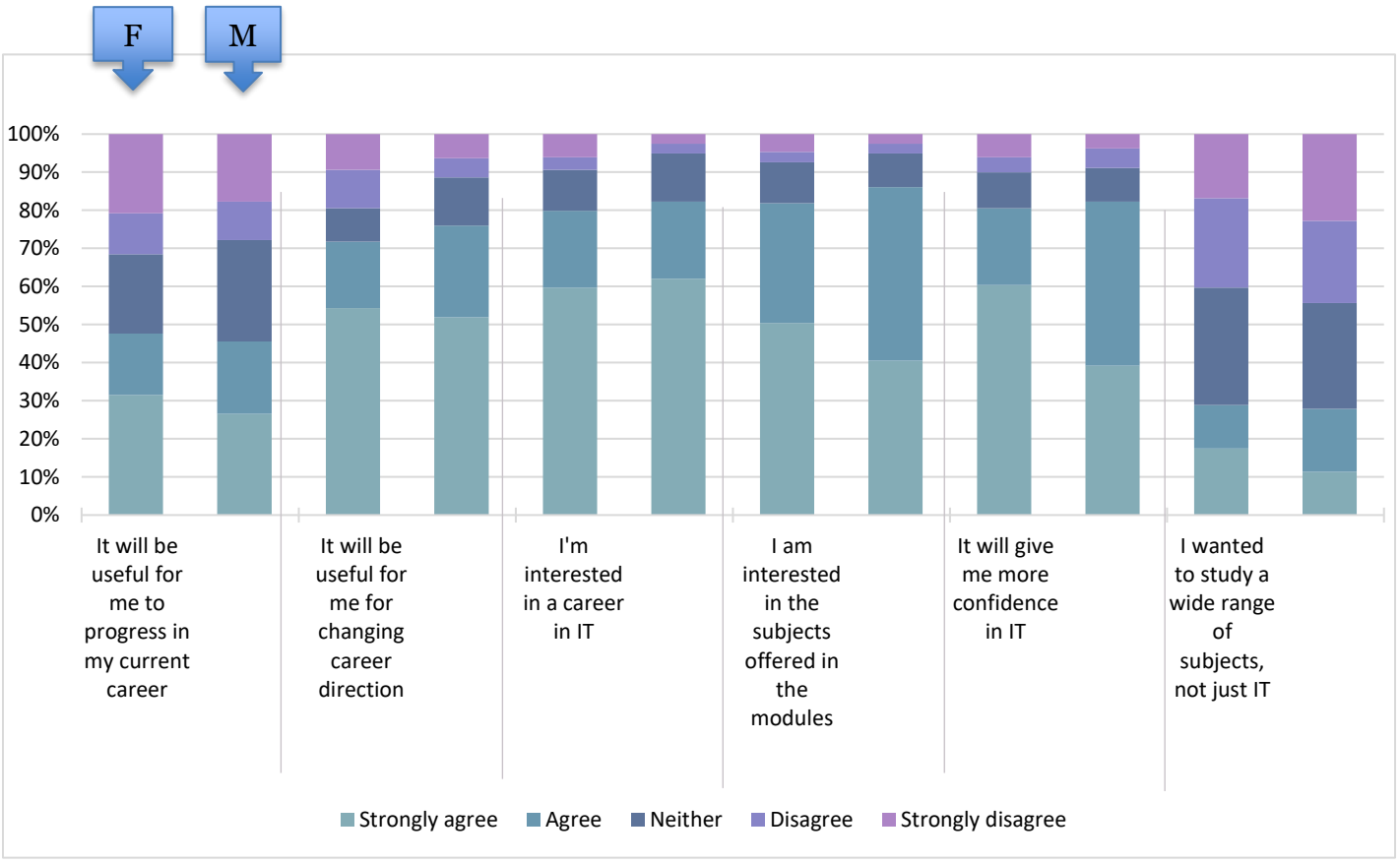


Figure 1: Degree choice motivation (F - left hand bars for female students, M - right hand bars for male students)

Opting for the joint honours was often an intentional and informed choice for women and was linked with aspirations for career change among those already in work. As Harriet, one of the focus group participants who works for a government agency doing technical support, explained:

> […] I am doing my degree in computing and IT with a second subject in Psychology. I chose this degree because I want to go into info sec... this degree will give me a grounding in IT knowledge as well as insight into the way people think with my additional subject of Psychology.

Even for students not currently in IT work, there was an awareness of the benefits of taking an interdisciplinary course to enable entry into new and upcoming fields. In other words, decision making was informed by labour market awareness and envisioning their future employability prospects. For example Sylvia, a 33 year old unemployed woman who had never worked in IT, was aspiring to enter the sector and recognised the value that having a joint degree in Computing and IT and Business could bring to her subsequent employment. She explained:

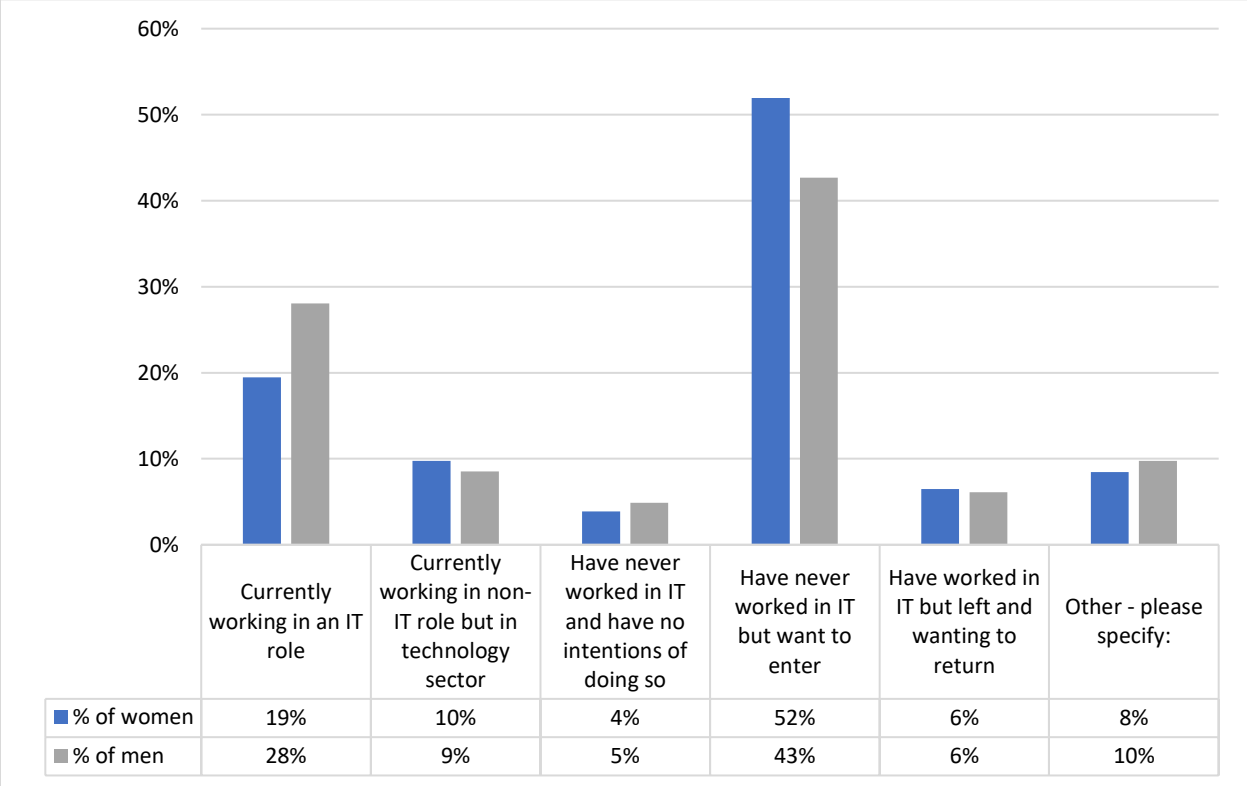
> In IT, to get up the ladder, they want you to have management experience. In business they want you to know about technology for e-commerce, data

protection, marketing etc., so knowing there was an option to study both this was something I couldn't afford to miss with my career goals.

Career change or career progression – gendered patterns
Overall women were more likely to be what we would define as career changers. This is supported by our analysis of the level of qualifications already held by participants. Nearly a quarter of the women (22%) already had a previous degree. Of these, nearly half (44%) had a degree in another STEM subject. This was significantly higher than the male students of whom only 16% had a previous degree and of those, less than a quarter were STEM graduates (23%).

There was a small difference between women who had a previous degree who were now studying single honours, 23% (n=14), compared to those studying joint honours, 19% (n=7), but as numbers are small, it is not clear whether a previous degree was significant in predicting which degree they chose.

Women as career changers was also evidenced via data about previous experience of working in IT (see Figure 2).



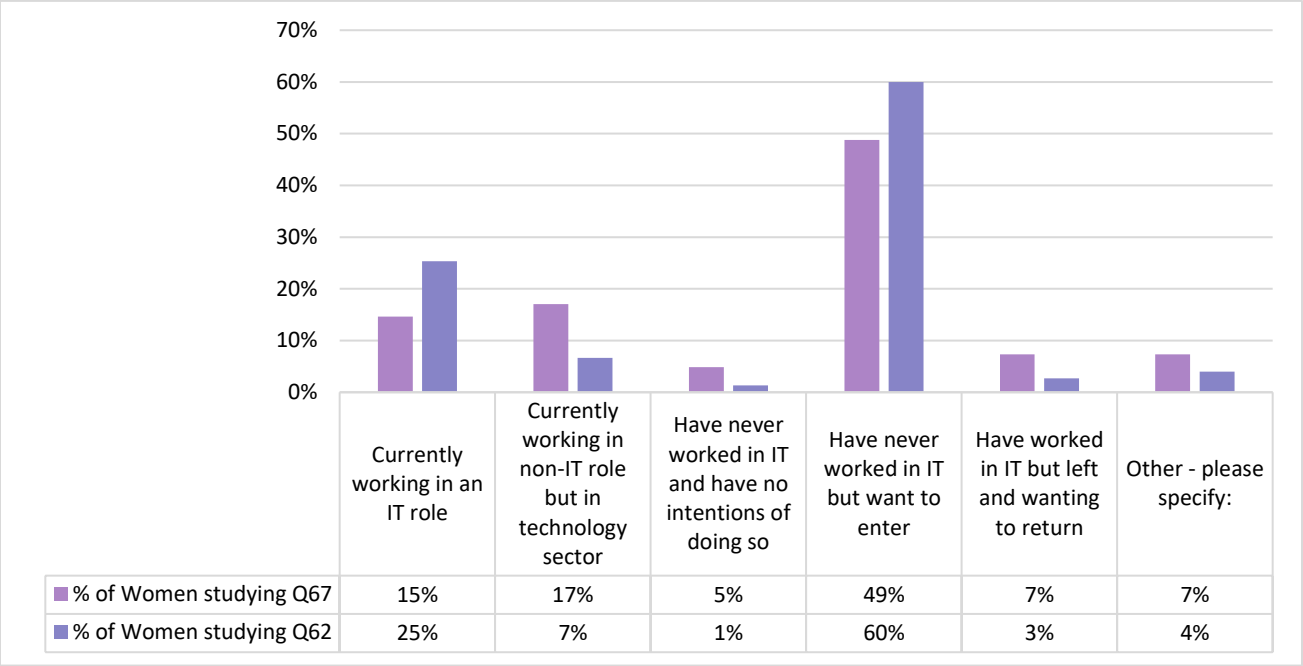
	Currently working in an IT role	Currently working in non-IT role but in technology sector	Have never worked in IT and have no intentions of doing so	Have never worked in IT but want to enter	Have worked in IT but left and wanting to return	Other - please specify:
% of women	19%	10%	4%	52%	6%	8%
% of men	28%	9%	5%	43%	6%	10%

Figure 2: Previous IT work experience by gender (figures illustrated are as proportions of each gender total, not of the overall sample total)

Whilst the responses to this question for men and women follow a similar pattern, with the most popular option being 'Have never worked in IT but want to enter' followed by 'Currently working in an IT role', Figure 2 shows that men are more likely to currently be working in an IT role than women (28% compared to 19%),

whereas women are more likely to never have worked in IT (52% compared to 43%).

Results for the same question but comparing women studying the joint honours degree (Q62) with those on the single honours degree (Q62) are given in Figure 3.



	Currently working in an IT role	Currently working in non-IT role but in technology sector	Have never worked in IT and have no intentions of doing so	Have never worked in IT but want to enter	Have worked in IT but left and wanting to return	Other - please specify:
% of Women studying Q67	15%	17%	5%	49%	7%	7%
% of Women studying Q62	25%	7%	1%	60%	3%	4%

Figure 3: Experience of working in the IT/Tech sector for women, by degree intention

The responses of both groups of women follow a similar pattern. Here, women who have never worked in IT are more likely to study the single honours degree (61%) than the joint honours (44%), as are those who are currently working in an IT role (23% compared to 17%). However, women working in the technology sector but in non-IT role are more likely to study the joint honours degree (17% compared to 8%).

Gendered expectations of success

Participants were asked about their confidence in their ability to succeed on the degree, whether they felt confident about being able to keep up with others and how their previous knowledge compared with fellow students. We asked this because of the Margolis and Fisher (2002) study (and subsequent work) which found that undergraduate women entered university computer science courses with less prior experience of computing than their male peers and that this affected their confidence and success (Margolis & Fisher, 2002). Results are given in Figure 4 for women and Figure 5 for men.

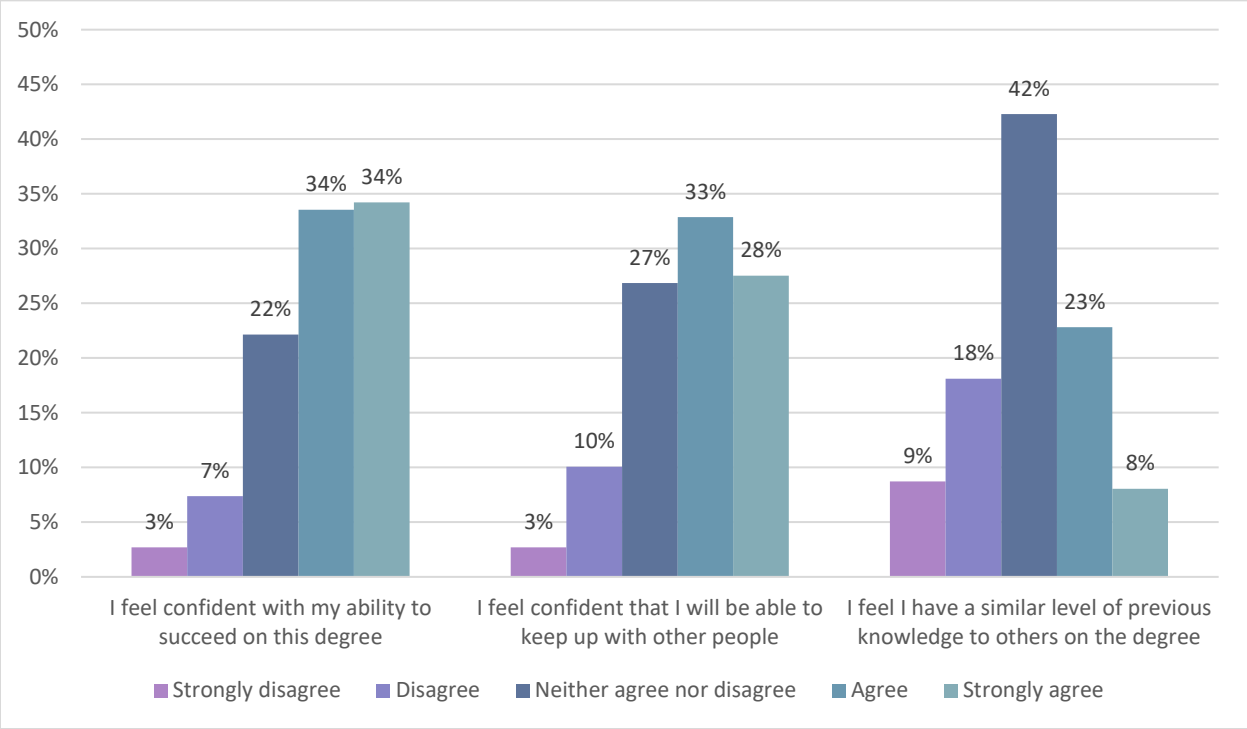


Figure 4: Gender and expectations of success: women's responses

Adding responses 5 (strongly agree) and 4 (agree) together for each of these statements shows that only 68% of women, compared to 81% of men, felt confident in their ability to succeed on the degree.

Similarly, women's confidence in keeping up with other people was lower than for men (60% of women compared to 72% of men. However, as Morag (a 35 year old retail manager who intends to move into IT following her degree) described, this changed once she was part way through the course:

> I felt really quite daunted before starting it as I could see from the 'Early Bird Forum' that the majority of people had more experience than myself, but .. my confidence grows every day, and I now feel happy that I will be able to keep up with other people on this module.

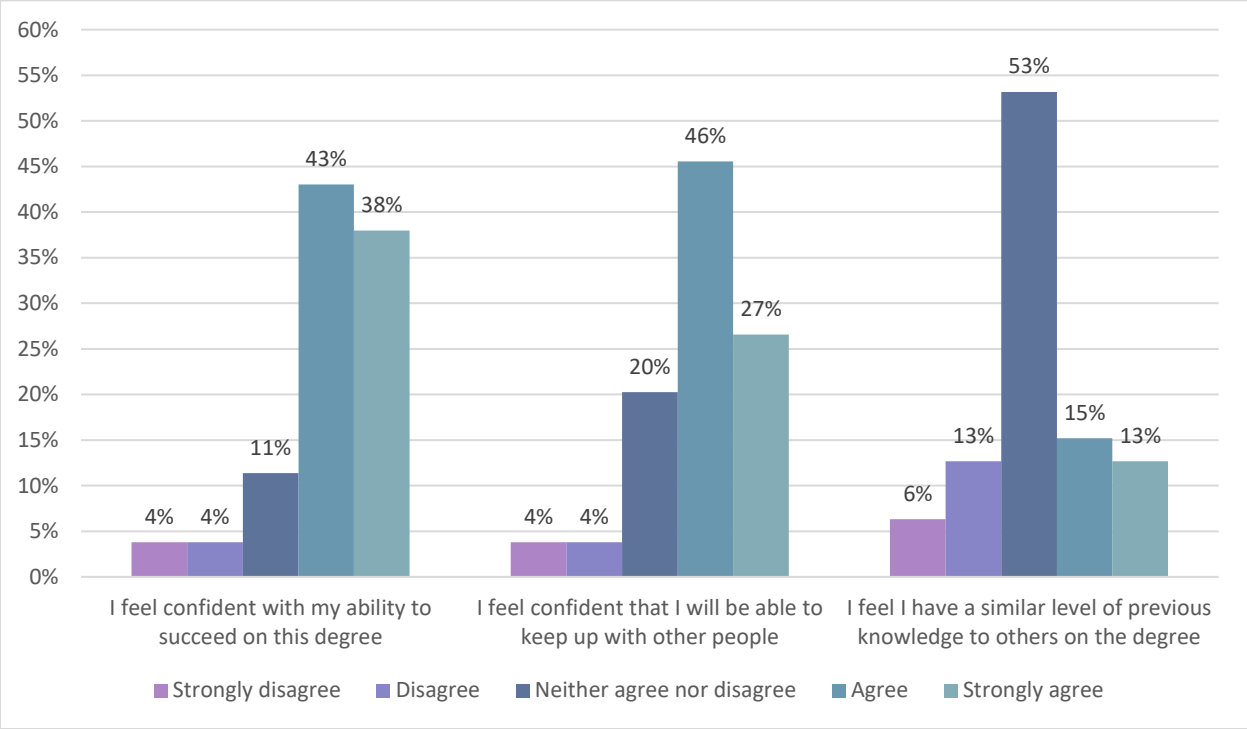


Figure 5: Gender and expectations of success: men's responses

Louise, who works part time as a Teaching Assistant and has no background in STEM studies, found that the prospect of studying a technical subject was initially daunting, but her confidence increased as the course progressed:

> from a technical perspective because my background is arts and humanities, I haven't really studied science or technology past GCSE a long time ago, so I certainly didn't feel very confident about the technical side of things, but I have been pleasantly surprised, which is great and I think my confidence has grown … I think the way that the courses are structured and the support that I have received has really helped to boost that confidence.

For those with previous technology experience, lower confidence was not related to the computing or IT content, but was more likely to be about studying in general. For example, as Billie, one of the focus group participants who works for a digital company in service management, commented:

> when I started I felt confident about IT, the computer side, but I think that is more because I have worked in the computer and technology sector for a good couple of years before deciding to do the course. The only thing I may have felt a little bit less confident about was just the general studying itself as being out of education for 5 years at that point. I think due to organising studying around work … that changed in the end and I felt fairly confident with it because I was able to organise everything

Gendered experiences of study

As shown earlier in Table 1, the majority of students on both Q62 and Q67 were men. Approximately one third of the women respondents enrolled on both qualifications agreed or agreed strongly with the statement that they felt aware of being in a minority on their degree (34% on Q62 and 32% on Q67). Studies have shown that lacking a sense of belonging within the computer science classroom can affect study experience and success, even within virtual classrooms (Cheryan, Meltzoff & Kim, 2011). However, the online nature of their studies perhaps helped to mitigate the potentially gendered experience of the learning environment, as 20 year old administrator Zandra, who is aiming to enter an IT and Computing career, describes:

> Being in a minority on the module never really affected me. It was simply a fact that I was made aware of over the course, but it never impacted my studies as I was more focused on continuing with the course and learning more about IT and Computing. In a way, it prevented the usual impacts of being a woman in the IT and Computing industry as I wasn't in a real-life classroom and I couldn't be intimidated by the male majority.

Some women, especially those who had already worked in the industry, described how they had adopted strategies in the workplace that have been observed in engineering firms, such as becoming 'one of the boys' (Jorgenson, 2002). For example, focus group participant Harriet described her immersion into a predominantly masculine working culture as being "just one of the dudes".

Intersectionality

Rather than regarding women as a unified group, there is increasing recognition that gender intersects with other characteristics in affecting opportunities, as well as motivation and choices. Crenshaw's (1989) use of intersectionality to examine the experiences of Black women is becoming widely used in gender and STEM research to understand the intersection of race and gender in gendered choices and outcomes. Overall 10% of our sample (n=25) identified as BAME (Black, Asian, Mixed or Other), a total of 18 women and 7 men. As these numbers were small, we did not identify any different patterns of enrolment between White and BAME women or men.

However, what we did identify was age and gender as significant intersectional factors – both for older and younger students. Just under a quarter (23%) of students were under 25 (n=59). For Shireen, who was fitting her studies around a full time IT job, being younger than average was something she had noticed:

> I am also aware of being one of the youngest students on this course (19 years old) and so some of the references in the learning materials do not relate to my experiences with IT

There was also a perception of age discrimination within the IT workforce, which might affect the employability prospects of older women. This was discussed in the

focus group and Louise, aged 43, described how she was "feeling age is more of a barrier to getting into the industry than the fact I'm a woman"

DISCUSSION

In this section, we return to our original research questions:

*Are female adult learners more **attracted** to computing when it is studied alongside another subject rather than on its own?*

Experience of the IT industry may be relevant to degree choice. The survey data indicated that male students are more likely to currently be working in IT role than women, whereas female students are more likely to never have worked in IT. The implications of this with respect to degree choice could be that some women are less sure of a specific career direction. These women do not have previous experience of a career in the IT industry and may prefer the breadth of a degree that combines computing with another subject to broaden their options. This was one perspective that emerged in the initial student consultation – a preference for developing a broad set of skills to avoid being 'pigeon-holed' into one role or career direction.

In contrast to this there was also evidence, from women studying the joint honours degree, of a preference for a degree that combines different subjects to enable access to a *more* specific career in computing (e.g. data science and cyber security) rather than more general computing careers. These comments suggested that these women had a good understanding of current opportunities in the sector, and what study would be useful preparation towards these.

Is there a gender difference among adult learners in motivation for studying IT and computing?

Women in our study were more likely to be career changers – moving into IT for the first time, whereas men were more likely to be seeking career development. Although 'entering IT for the first time' was the most commonly cited motivation for both men and women students, this was more likely to be a motivation for women (52%) than men (43%). Men were more likely to be already working in an IT role than women (28% compared to 19%). This was corroborated by the fact that a greater proportion of the women had previous degrees, and of those with previous degrees more of these were STEM subjects. This aligns with previous research about women's career trajectories, with women more likely to have non-linear 'frayed' or broken careers, which might include periods out of employment doing family care, and returning to sectors other than their original degree subject (Herman, 2015; Sabelis & Schilling, 2013).

Women already working in the technology sector but in a non-IT role were more likely to be studying the joint honours computing and IT with another subject. We can interpret this as being an informed choice to undertake a degree that included range of subjects combining computing with another subject, a qualification that could widen their choice of career options in the sector or take them into a particular new growth area.

*Are there gender difference in adult learners' **confidence** in their ability to study IT and computing?*
Women expressed less confidence in succeeding and keeping up but were no less confident than men in their previous knowledge. This may be because the women in the study were more likely than the men to already have a degree and in particular a degree in another STEM subject. The open comments and focus group responses suggest that lower confidence in succeeding and keeping up could be due to time pressure rather than confidence in computing or ability. They were juggling their studies with other commitments and work, which meant that they were their studying in the evenings and fitting this around childcare. Thus, confidence cannot be seen in isolation but needs to be seen within the context of gendered cultures within IT, as well as the trajectory of women's careers. For example, within the focus group, confidence was talked about with respect to networking and knowing how to speak in the language expected in the technology industry. In order to gain confidence, there was a desire to practise networking and talking to people about working in the industry, as well as hearing about the opportunities available.

CONCLUSION

We started out by considering that women's choices for joint rather than single honours degrees was a cause for concern. Extremely low representation of women on computer science degrees has been identified as a major problem and the point for intervention in many countries (Frieze & Quesenberry, 2019) so we concluded that if women were diversifying their studies this was somehow not achieving the objective of increasing women's participation. Our findings made us question whether this was the right way to look at these choices. As a route into specific roles within the computing and IT professions, computer science degrees are just one metric, and indeed this is how the UK Higher Education sector and many other global indices measure participation rates. However, what we know is that employment opportunities within the sector are wide and diverse. For mature learners, motivation and choice is less likely to be influenced by peers, teachers, parents or media representations of women and tech, than would be the case among adolescents in high school. Rather, the motivation of mature women is much more related to their employment potential, and reflects real world knowledge of job markets, and experience of workplaces. Thus, the usual assumptions that are applied when looking at the women and IT problem from the pipeline model are not appropriate (Blickenstaff, 2005). Women in our study had made an active choice for a joint honours study programme precisely to fill educational/knowledge gaps (e.g. in the case of mathematics and statistics) and to prepare themselves for new jobs and careers. Returners or career changers were embarking on the acquisition of new skills at a particular life course transition point and continuing their journey of lifelong learning (Castaño & Webster, 2011).

Women students in this study have demonstrated agency in their own career trajectories. As the focus group discussion revealed, study choices were made from a position of knowledge of the labour market and almost always made with a specific career or employment goal in mind. This contrasts with studies of younger girls and women whose perception and knowledge of actual jobs is often what inhibits them from making a choice for computing, and where interventions are

often focused on developing interest in the subject through workshops and other hands on activities (Cuny & Asprey, 2002). In addition, we found that concerns around confidence were much more likely to be related to juggling current careers, caring responsibilities and study, or to do with entering a new career at a later stage in life, rather than around ability or uncertainty about the study of technology itself.

Adult learners are a compelling sample because they emphasise that studies of gender and careers can benefit from a life-course perspective and can add to intersectional understandings of under representation by bringing in age/life-stage as a variable in the same way as considerations of ethnicity/race have enriched previous understandings (Moncaster & Morris, 2019). Future interventions and strategies to address skills shortages in the IT sector must take a life-course perspective into account. However, targeting older women for retraining will not suffice to resolve the gender digital divide. Companies must recognise and tackle the predominant male biased culture within the industry, offering flexible career routes that reflect women's lives, and improve the retention and return of their women employees. Moreover, efforts must continue across all stages of the life-course to address stereotypes, media, peers and teachers who will influence the career choices of the next generation.

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APPENDIX 1 – Survey questions

These questions are about your choice of degree

1. When you registered what was your degree intention? (select one)

- BSc Computing & IT (i.e. Q62 or B62)
- BSc Computing & IT & another subject (i.e. joint honours: Q67 or B67)
- BA/BSc Open Degree
- None - I did not intend to study for a degree (these students can still answer Q4 & 5 but should skip Q2, 3, 6 & 7)
- Other (please specify: Open comment box)

2. Thinking back to when you first registered for your degree, did you see any marketing or publicity, or speak to an OU advisor, specifically about this degree? (select all those that are relevant)

- Website
- Prospectus
- Posters
- Spoke to an advisor
- Other (please specify)
- None of the above

3. If yes to the above, did this initial contact influence your decision about your choice of degree?

If yes, please explain: (Open comment box)

These questions are about your study of TU100.

In the following questions please rate each item on a scale from 1 to 5, where:

1 = Strongly disagree	2 = Disagree	3 = Neither disagree nor agree	4 = Agree	5 = Strongly agree

4. Think back to your reasons for taking TU100:

It was required for the degree I registered for	1	2	3	4	5
I enjoy IT/computing	1	2	3	4	5
I wanted to know more about IT/computing	1	2	3	4	5
I wanted an introduction to a range of IT topics	1	2	3	4	5
The content looked like it would be useful for my work	1	2	3	4	5

Please let us know if you have other reasons for taking TU100: Open comments box.

5. How did you feel about taking this module?

I felt confident with my ability to succeed on this module
1 2 3 4 5
I felt confident that I could keep up with other people on this module
1 2 3 4 5
I felt aware of being in a minority on the module because of my gender
1 2 3 4 5
I felt I had a similar level of previous knowledge to others on the module
1 2 3 4 5

Please let us know if you have any other comments on how you felt about taking TU100: Open comments box.

These questions are about your choice of degree.

In the following questions please rate each item on a scale from 1 to 5, where:

1 = Strongly disagree	2 = Disagree	3 = Neither disagree nor agree	4 = Agree	5 = Strongly agree

6. Think back to your reasons for choosing the degree programme that you are registered on (e.g. computing and IT, computing and IT and another subject, Open Degree etc.).

It will be useful for me to progress in my current career	1 2 3 4 5
It will be useful for me for changing career direction	1 2 3 4 5
I'm interested in a career in IT	1 2 3 4 5
I am interested in the subjects offered in the modules	1 2 3 4 5
It will give me more confidence in IT	1 2 3 4 5
I wanted to study a wide range of subjects, not just IT	1 2 3 4 5

Please let us know if you have other reasons for choosing this degree: Open comments box.

7. How do you feel about taking this degree?

I feel confident with my ability to succeed on this degree	1 2 3 4 5
I feel confident that I will be able to keep up with other people	1 2 3 4 5
I feel aware of being in a minority because of my gender	1 2 3 4 5
I feel I have a similar level of previous knowledge to others	1 2 3 4 5

Please let us know if you have any other comments on how you feel about taking this degree: Open comments box.

About your background and career

8. What (if any) has been your experience of working in the IT/Tech sector?

(select one)

- Currently working in an IT role
- Currently working in non-IT role but in technology sector
- Have worked in IT but left and wanting to return
- Have never worked in IT but want to enter
- Have never worked in IT and have no intention of doing so
- Other (please specify)

9. If you have moved into IT from another role what was your previous occupation?

[Drop down box of occupation sectors]

10. Did you already have another degree before you started this degree?

If yes - what subject was this in? [Drop down box of degree topics]