



THE UNIVERSITY
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**Data-Driven
Innovation**

Part of the Edinburgh & South East Scotland City Region Deal



Women in Data



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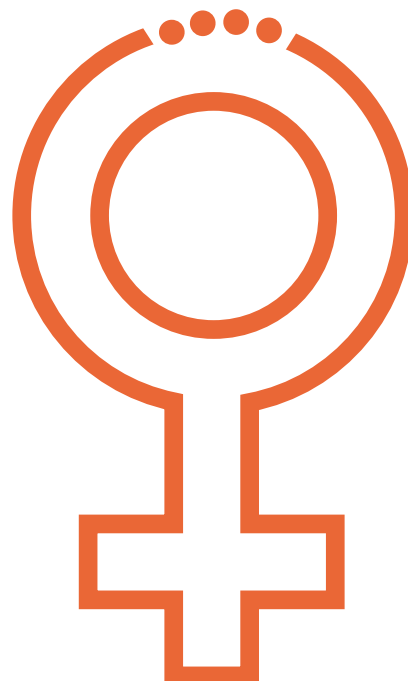
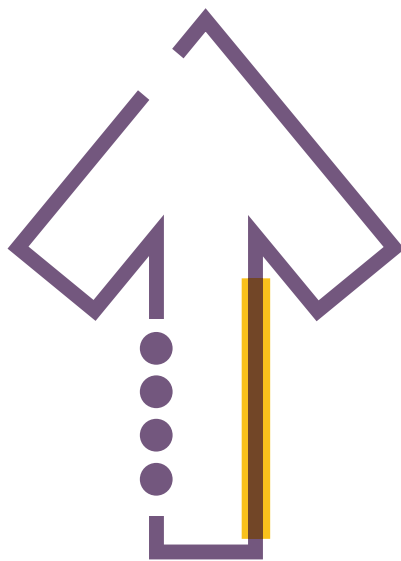
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Introduction

The Data-Driven Innovation (DDI) Women in Data campaign showcases the rich landscape of women working with data science, technology and innovation across a diversity of industries, fields and sectors in the Edinburgh City Region. I am so proud to share their incredible stories with you through the final piece of this campaign – the Women in Data report.

In January 2019, I joined the DDI team to deliver the *Women in Data* campaign. We interviewed over 60 women and delved into the University of Edinburgh Centre for Research Collection Archives with the help of experts Rachel Hosker and Professor Melissa Terras, to create profiles and articles on women's careers past and present.

From students to government ministers, chief executives to lab technicians, the project captures the highly-skilled, innovative work of the City Region's women of yesterday, today and tomorrow. By sharing their fascinating journeys, we intend to educate on and celebrate women's profound contributions to, and leadership within, innovation, technology and data.

We hope to demonstrate to women and girls across Scotland that others 'just like them' are thriving in these areas – including from atypical, non-academic and 'non-scientific' backgrounds. This campaign aims to provide role models, showing that women are at the forefront of technological advancement in Scotland, challenging perceptions that scientific and innovation work is 'just for men'. It looks to the past at what we have achieved and to the future on what needs to be done.

The project has also highlighted critical conversations on the state of gender equality in these sectors and industries, and on our own doorstep, following on from the launch of the *Women in Data* campaign at the DDI conference 'Doing Data Right' on 10 September 2019, where we welcomed Caroline Criado-Perez, author of *Invisible Women: Exposing Data Bias in a World Designed for Men*. We now invite you to be part of this bold conversation – please enjoy this report and share the [60+ Women in Data profiles](#) with the women and girls in your life.



In the 1870 'Surgeons' Hall Riot', the [Edinburgh Seven](#) were pelted with rubbish and mud for entering a medicine exam at the University of Edinburgh. Now, on International Women's Day 2020, we share with you the modern scientists and academics who walk on in their footsteps, doing just what those women fought to do – study, learn, qualify, practice, lead, challenge, discover.

150 years on, we still have some way to go. The passion and enthusiasm I have witnessed during the *Women in Data* project show that people are ready for more change and excited to listen, and be heard, when it comes to gender inequality. It has been a privilege to lead on the project and gain fascinating insights into the revolutionary work women are doing right in front of us everyday – studying space, robotics, big data, our planet, building and using mind-blowing technology – within the walls of their offices, labs and classrooms. And as our Edinburgh historians tell us – [women have always been doing this](#) – we just need to listen.

Huge, indebted thanks to the participants for their generous contributions of time – and for challenging me on my own presumptions on what the project would be and say. Thank you to the project supervisors, Professor Judy Robertson and Mark Baillie, for their wise advice. I have learnt so much from you, and I hope you can learn something from our campaign.

Poppy Gerrard-Abbott
*University of Edinburgh PhD Sociology candidate
& Women in Data project lead*

Visit ddi.ac.uk/women-in-data
[@DataCapitalEd](#) [#WomeninData](#)

Welcome

Jarmo Eskelinen

Executive Director, Data-Driven Innovation initiative, University of Edinburgh

The Women in Data campaign has allowed Data-Driven Innovation to engage with all the cutting-edge work of women across the City Region, and with crucial conversations about how we deliver truly inclusive growth.

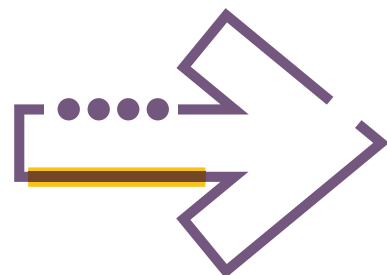
The campaign is part of our responsibility to promote gender equality in the City Region Deal and at the core of this is that equality is not just desirable, but necessary for our work to be sustainable and successful – and I'm absolutely committed to this message as Director at DDI.



Professor Judy Robertson

Chair in Digital Learning at the University of Edinburgh School of Education and School of Informatics

Because we know that the tech sector in Scotland and the rest of the world is largely male-dominated, it's important that women and girls see the range of amazing work which our interviewees do through the Women in Data campaign. These women are using data to explore and change the world – I hope girls at school are inspired by them.



Background

Data science is a relatively new discipline and is increasingly seen as part of the STEM (Science, Technology, Engineering, and Mathematics) umbrella of subject areas. However, as an emerging field, in-depth research around gender equality in data science is yet to develop.

The Scottish Government states it is widening its approach to STEM to be inclusive of data science and digital skills (Skills Development Scotland, 2017). This is supported by the main findings of our *Women in Data* campaign, which finds that data and digital are fundamentally central to STEM and its future. STEM disciplines are rapidly benefiting from the high-powered gathering, processing and application of data.

Research on sexist bias in data science, STEM, and workplaces presents a clear picture of gender inequality. Research and journalism on data science indicate that gender inequality patterns from STEM map on to data science and artificial intelligence (AI) fields.

This is all an urgent concern for Scotland as it enters the fourth industrial revolution with its data science and technology fields booming and attracting [large levels of development and investment](#) and with a [STEM skills gap of around 7.7%](#) (Scottish Government, 2019).

Addressing a Scottish context – and a wider UK context where Scottish research is absent – this report addresses how STEM gender inequality occurs by considering the ‘pipeline’ of women and girls from education through to the workplace.

Learning from history

As part of the Women in Data campaign, we conducted research with the University of Edinburgh’s archive teams to reveal that women have been working in STEM long before they were widely believed to have even entered the formal work sphere, let alone science and technology. Stand-out examples include the ‘Bletchley’ Park women, who have connections to Edinburgh city and the university and created code-breaking methods to intercept the Nazis in WWII. There are also annual celebrations at the University of Edinburgh, across Scotland and the UK for the inventor Ada Lovelace, who programmed the modern general-use computer on paper, known as just her *Notes*, used by Alan Turing.

This reveals how the telling of history itself is often recounted in sexist ways, sustaining myths that women were absent from STEM, and the ‘formal economy’ workplace, until they ‘went to work’ in the 1950s onwards.

Gender stereotypes

Women’s representation in STEM jobs is attributed to social and cultural views around legitimate ‘women’s work’ and ‘men’s work’. These widely-held perceptions are taught to us early in our lives and are going strong, even in developed economies like Scotland (Scottish Government, 2017). Trends from early socialisation follow through to the labour market. STEM is reported to be the most pronounced area of the labour market for gender segregation (European Institute for Gender Equality, 2017).

Gender stereotypes shape the STEM gender gap by creating stronger connections between boys and STEM, based on widely-held and institutionalised perceptions that boys are better at STEM than girls because of naturally-occurring sex differences in the brain. Researchers Master & Meltzoff (2017) frame gender stereotyping in two ways – that it perpetuates a ‘cultural fit’, which asserts that girls lack interest in sciences and that boys prefer it, and an ‘ability fit’, which assumes girls lack ability and boys possess greater ability at science.

School and early education

Evidence paints a picture contrary to stereotypes and myths surrounding boys' and girls' abilities. The WISE campaign's research (2018) tells us that girls are outperforming boys in most areas of STEM at GCSE level, with 67% of girls achieving A*-C/9-4 grades over 63% of boys. Mathematics and Physics are the only subjects where this marginally fluctuates, where girls are on par or scoring slightly lower – 59% of girls achieved 9-4 grades vs. 60% boys in Maths and 90% of girls achieved 9-4 grads vs. 91% of boys.

The Scottish Government's Young People in Scotland survey (2017) finds that among school pupils (11-18) girls are much more likely to report low-confidence in their STEM abilities compared to male classmates – 40% vs 17%. Additionally, 34% of boys compared to 24% of girls say they intend to pursue a STEM career.

The Scottish Government reports (2017) that at all levels of schooling, male pupils make up the majority of entries for STEM subjects. Although this means there are more boys on the course, girls' pass rate is higher than boys' pass rate at all levels, particularly at Advanced Higher level. However, three quarters of those studying Physics at school are male. Technology and engineering have some of the worst records for take-up and completion from girls – for technology, the percentage of male school leavers achieving a National Level Qualification is double that of females.

Yet, in 2018 Advanced Higher Subjects, more girls than boys were awarded A and B grades across all STEM subjects, particularly in computing where 63% of entries by girls were awarded top grades and 46% of entries by boys.

Further and higher education

According to UCAS, 35% of UK STEM students in higher education are women. Just 16% studying engineering and computing sciences has fallen from 16% to 15% in the UK (HESA, 2019). Likewise in Scottish universities specifically, engineering is the worst performing STEM discipline for attracting women on to Higher Education (HE) courses, with a reported 85% of engineering undergraduates being male (Scottish Funding Council, 2018). This poor track record in engineering worsens as women move in to employment – just 11% of engineering jobs in Scotland are occupied by women (Equate Scotland, 2019).

Retention of women and girls in STEM more widely, is also very disappointing post-HE, with a staggering 73% of young women who study STEM disciplines dropping out from a STEM career in Scotland (Skills Development Scotland, 2015). Women make up just a quarter of UK STEM university graduates, meaning that the STEM gender inequality gap widens in from school to further education to working life (WISE, 2017).

Inequality is also found in the gender pay gap in Scottish universities. Women academics, on average in Scotland, earn 86.9% of the salary paid to male academics. There is a full-time gender pay gap in Scotland of 5.7% (Scottish Government, 2019) and this is slightly higher for full-time STEM workers at 7%. However, this figure provides an average of overall salaries across STEM – the gap worsens in particular areas of STEM, reported at 20% for health, 30% for skilled trade, 18% in both manufacturing and electricity, gas, steam and 10% in construction (NACWG, 2018).



Workplace culture

The climate of STEM workplaces raises the difficult question of whether we should encourage women and girls in to the area based on evidence that they may be poorly rewarded for doing so. When women enter male-dominated work, this can have significant psychological and emotional impacts on their identity and wellbeing (Veelen, Derks & Endedijk, 2019).

There is currently very poor retention of women and girls from schooling through to the workforce in STEM, known as the 'leaky pipeline'. In the UK, there is a similar level of take-up between boys and girls for STEM GCSE subjects (WES, 2018). In adulthood, despite women comprising half the national workforce, just 13% of STEM jobs are occupied by women in Scotland (Skills Development Scotland, 2015), showing the widening of the leaky pipeline from education to employment. Just 8.2% of engineering apprenticeships are held by women. The UK has the lowest percentage of women in engineering professionals in Europe, at less than 10% (WES, 2018).

For women who do enter STEM, they are much less likely to achieve seniority, with women accounting for only 10.7% STEM FTSE 100 directorships compared to 14.7% in non-STEM companies (Financial Times, 2011).

Studies have found that women experience complex forms of indirect discrimination in STEM workplaces. Policies and procedures designed with equality and fairness aims are failing to eradicate discriminatory occupational practices (Hart and Roberts, 2011). Efforts to create genderless 'merit-based' systems of competition are still influenced by sexist stereotypes and they universalise male experiences of work – such as less interrupted careers – as the norm (Royal Society of Edinburgh, 2012).

Sexual misconduct in STEM workplaces is speculated to be more severe than all other professions except the military, according to the USA's National Academies of Sciences, Engineering, and Medicine (NASEM, 2018). The recent NASEM report states alarming findings that nearly 50% of women in science and 58% women in STEM academia report sexual harassment.

This comes at a great cost to innovation. The Royal Society of Edinburgh (2012) estimate that doubling women in STEM could add £170million to Scotland's economy. Diverse workforces are thought to be more sustainable and productive, with greater organisational performance, worker morale, staff retention, effective governance and recruitment from the widest talent pools (Thomson & Hakeem, 2016). Maximising equal opportunities for women at work is necessary for reaching national GDP potential (McKinsey Global Institute, 2016:4) and companies play an essential role in social and political progression as they hold significant power to influence social attitudes externally (2015: 86). However, the workplace is a key site where gender inequality widens as women progress from childhood (McKinsey Global Institute, 2015).



Women in Data Interviews

Interviews formed the basis of the Data-Driven Innovation Women in Data campaign by capturing the stories and careers of over 60 women and women's groups in Edinburgh.

These interviews also provide a valuable dataset in response to a lack of research on gender equality in data and a lack of qualitative insight in to women's experiences of STEM workplaces and studies.

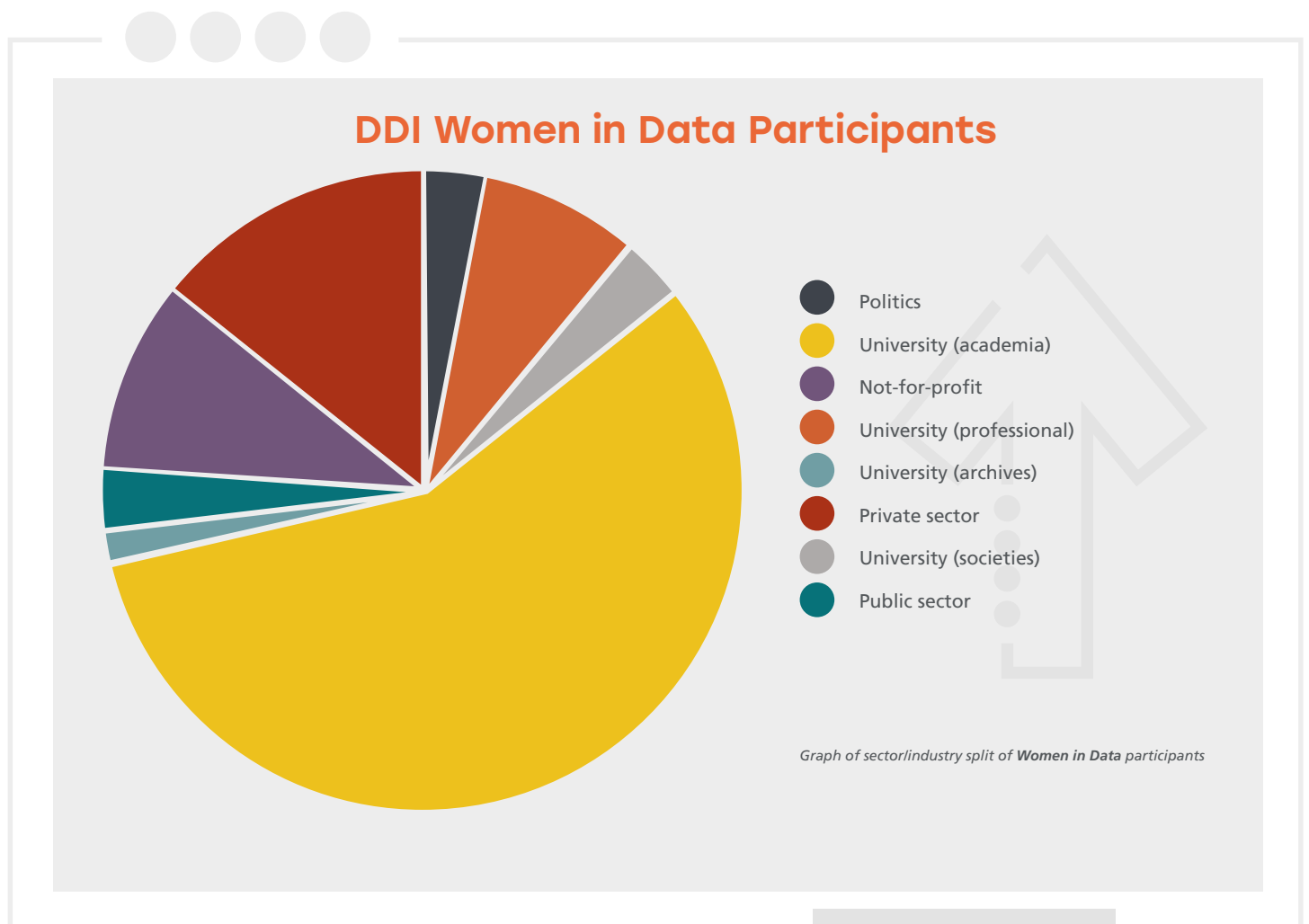
Using the qualitative tool *NVivo*, the Women in Data interviews were thematically grouped and findings are presented below. These findings communicate the 'headlines' of the interviews and we hope they can offer direction for employers, companies and organisations in Scotland to do better.



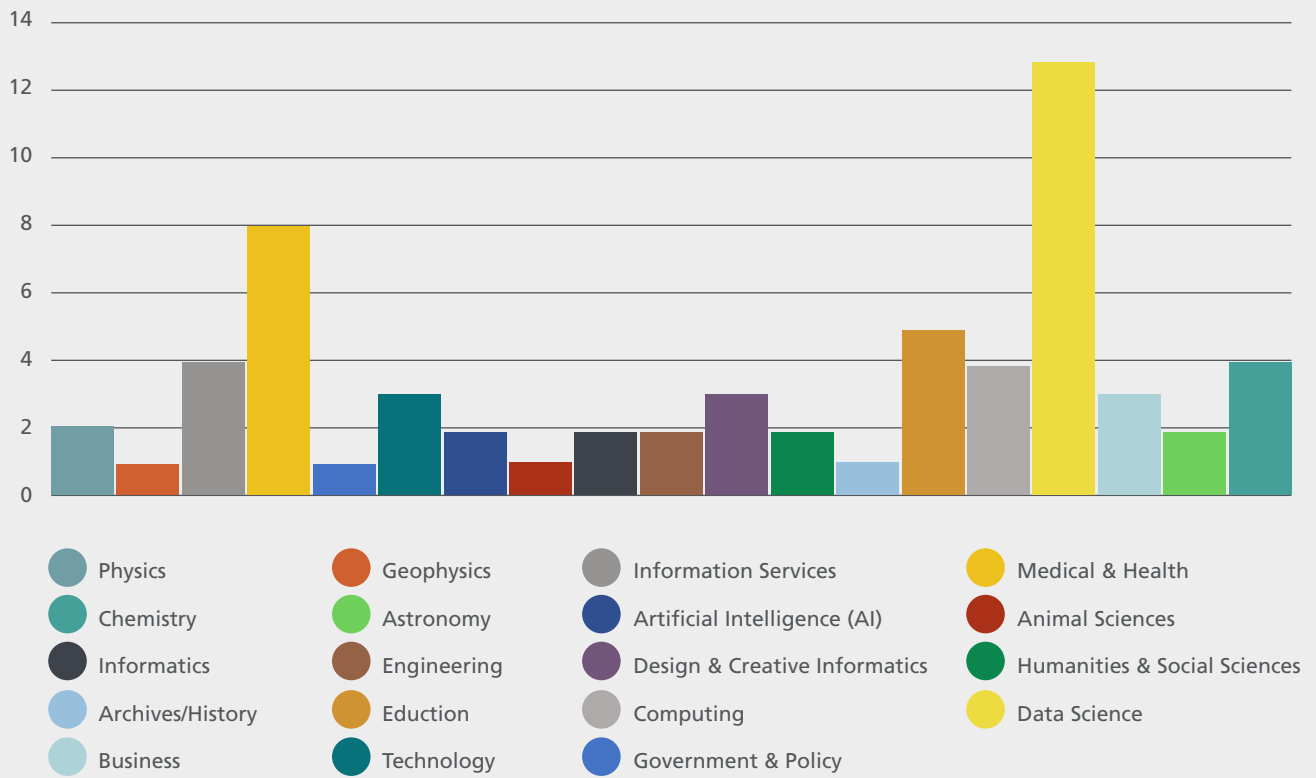
Who were the participants?

Sixty-four profiles were created, hosted on the Data-Driven Innovation [website](#), consisting of one government minister, one MSP, two public sector employees, six from not-for-profit organisations, nine from private companies and 44 university employees (36 academia, five professionals working at universities, two student societies and one profile based on University of Edinburgh archive collection research).

Out of the university participants, 32 work at the University of Edinburgh, four at Heriot-Watt University, two at Edinburgh Napier, and one at the University of Glasgow. The DDI initiative forms a partnership between the University of Edinburgh and Heriot-Watt, meaning that the greatest number of participants are from these institutions and allowed for 'snowball' recruitment. Edinburgh Napier participants were recruited through word-of-mouth and professional connections of participants. The University of Glasgow participant is a senior woman in computing whose work spans the wider Scottish context and is connected to Edinburgh. All participants were based in the Edinburgh City Region except two participants – Professor Muffy Calder from the University of Glasgow and Katie Barker Ward, a University of Edinburgh graduate.



DDI Women in Data Participant Discipline/Area



Graph of disciplinary split of Women in Data participants

Main findings

1. There are many exciting opportunities in data and participants are pleased that women are making progress in their field

Participants often reflected on how society now has more opportunities and support for women than in the past, and this relates to greater corporate responsibility on the issue. Participants further in their career want to see companies encouraging young women to take opportunities arising in Scotland's booming STEM labour market, as the country enters the 'fourth industrial revolution'.

"In my first job I was one of 20 women on a 250 person industrial site... things are much better now."

Nicola Osborne



"My vision is to intersect the energy and determination of young women and the opportunity that new technology provides."

Alison Muckersie



"Not everyone has opportunities available to them... I believe it is our responsibility to engage, where possible, with our next generations to enthuse them with the exciting opportunities available to them and putting in extra effort to unblock obstacles which may stand in their way."

Mia Dowman



"Throughout my career I have had the opportunity of being appointed to promoted posts from a young age and I am delighted to be the first Chief Executive of Midlothian Council. It has been a privilege to be involved in the DDI work which is having a positive impact on Newbattle Community High School, which is our Digital Centre of Excellence."

Dr Grace Vickers



2. Progress is uneven across different subject areas

Some areas of STEM are still highly male-dominated and male-centred, both in terms of representation and culture. There is concern that complacency and over-assuming progress is becoming the norm.

Gender equality is also not consistent across all areas of STEM. Disciplines and sectors that have taken off more recently, such as data science and projects merging arts, humanities and STEM, enjoy better representation of women. Other fields, particularly engineering and physics, have seen slower change and persist in being heavily male-dominated. Narratives on this issue, and research in to the issue, must avoid homogenising STEM, present a more nuanced picture of progress and look to identify specific characteristics within disciplines that are slowing or accelerating progress.

“Data and technology are generally male-dominated industries, and in some organisations that can breed a ‘boys-club’ culture.” *Elizabeth Hollinger*



“Especially in a still fairly male dominated tech environment it can be challenging as a woman to be taken seriously or to be seen as an expert....cryptocurrency or blockchain are often very male and can seem intimidating. I believe not just education but societal and cultural perceptions of male/female professions and gendered stereotypes need to be further demolished.” *Bettina Nissen*



“The data is telling us that we’re not in an equal society and that this is negatively impacting women.” *Fiona McNeill*



3. Our participants want to make a difference with data

Participants often showed interest in the ethical aspects of data and some discussed links between the skills of women and being attracted to areas of STEM with opportunity to make social and political impact. Many are interested in ethical big data projects and are keen to do work around educating people in data.

“There is quite a lot of excitement around data-driven technologies, but there is also the flip side of potentially disregarding the effect of these technologies on people and society more broadly, particularly in the long term.”

Larissa Pschetz



“Social purpose was definitely the driver for me. Not just to do academic projects that produce publications but getting valuable, actionable insights and having an impact on children locally, nationally and globally.”

Alex Hutchison



“That is what gets me out of bed in the morning; the idea that medical statistics are improving care for people and making a real difference to people’s lives, in a world where ethics and good practice are the reason for doing what you do, not profit.”

Steff Lewis



“Innovation is about improving services to improve people’s lives, and that’s what gets me excited. I suppose the way we do that is through collaboration. Some people are interested in the investments that go in to data and technology, or the specific technologies themselves, but it’s about how we use it to improve lives.” *Kate Forbes MSP*



4. Data jobs are varied - they need an interdisciplinary mix of skills from technical to team-working

Participants have a large degree of inter-disciplinarity and collaboration in their work, and many cited this as conducive to work satisfaction. Most said there was 'no such thing' as a typical day and enjoy the skills development and personal challenges that come from this. Many brought up the integration of STEM and the humanities, social sciences and arts as essential for successful and sustainable innovation and desire more opportunity to collaborate and more value to be awarded to this at work.

"I really enjoy the collaborative aspect. I have my skills, the people in the commercial team have their understanding of the retail world, the people in the data team have their own technical and coding understanding and you watch it all come together to make something actionable and alive."

Alice Mortlock



"I'm extremely passionate about blurring the margins of creative and technical work as, having spent years working in IT and Software development, I know just how creative and imaginative you need to be to build something new... creative people from all backgrounds can bring so much to technical approaches."

Nicola Osbourne



"What we're developing are very forward-looking and interdisciplinary programmes that take data skills seriously and are designed around global issues and complex questions that arise from the social sciences and humanities. I'm working with a terrific group of academics from across the University."

Siân Bayne



5. We should emphasise the professional achievements of women in data

There were many examples of women achieving seniority and career success in highly male-dominated environments, showing that women are not just surviving but thriving 'against the odds' in STEM. Participants are keen to have their skills and achievements recognised, especially of working as one of few, or the only, woman. The history of women succeeding in STEM needs to be uncovered and the stories of their present achievements and contributions needs to be made general knowledge to challenge myths and stereotypes.

"I was the only female undergraduate physicist in my year....The International Astronomical Union named Minor Planet 5914 kathywhaler after me on my birthday in 2006, the year I completed my term of office as Royal Astronomical Society President." *Kathy Whaler*



"I've been struck, for example at software developer events, at the amount of women there showing off their projects. I didn't come from a computer science background – my IT involved a BBC basic computer programme! Now, 20 years on, I've had a career in politics, and hold an MBA from the Open University and an MA, M.Litt and now an honorary doctorate from the University of St Andrews." *Catherine Stihler*



"I had a great four years at Edinburgh, though at the time there were very few women teaching in the Department. At Cognitive Geology, and at RSI before that, we have as many women in senior technical roles as men." *Lucy MacGregor*



6. Diversity has many angles

Participants have differing relationships with the 'women in STEM' concept, with many finding it a simplistic view of inequality issues in STEM. All participants acknowledge that highly gendered treatment occurs in STEM workplaces. They recognise the centrality of women within efforts to have more inclusivity and diversity in STEM. However, they often see this as connected to a much wider scope of diversity objectives to be considered in recruitment and promotion practises that support all marginalised groups to access STEM. When speaking about being a 'woman in STEM', participants appreciated times when they are treated and valued as truly equal members of a team, and desire treatment based on skills.

"It isn't necessarily women. You need good people doing good things!"
Fiona McNeill



"I did not feel specifically supported 'as a woman' but I do as a person and a team member."
Katie Barker Ward



"I struggle with the idea of doing anything particularly 'for girls'... In terms of data and computing as careers, we need more women but we need more of everybody."
Kate Farrell



7. Diversity leads to workplace innovation

Participants report diversity having multiple impacts on workplaces and often cited research that diversity is needed for innovation. Diversity and inclusion took on a variety of meanings in the interviews, such as safety, happiness and cohesion. It was sometimes applied in non-traditional ways, such as focusing on men entering female-dominated industries, and addressed different areas like diverse employees, diverse opportunities and institutional willingness to facilitate diverse lifestyles and needs.

“There are still some industries that are heavily male-dominated which can put women off choosing them when planning their career...I am in a very lucky position. In Merkle Aquila, we have a 50:50 split in our company.”
Marta Portugal



“Make your workplace more inclusive and somewhere women want to work.”
Talat Yaqoob



“The College of Technology had a 50:50 intake policy... it just felt so welcoming. The atmosphere, or what was being presented, appealed to me. The programme also had the opportunity to study psychology, economics or accounting as part of the business element of that degree. That diversity was particularly appealing... I deliberately chose an environment that was diverse and supportive of women. They are out there.”
Clare Adamson



“We need to make sure the Arts and Humanities, the social scientists and psychologists are as involved in shaping this future. It is not just about STEM – I prefer the acronym STEAM [inclusive of Arts]. Think of how these disciplines can help answer big questions and bring diversity of thought.”
Gillian Docherty



8. There are many routes into data roles

Although the recruitment channels for the Women in Data participants meant that most went to university, there was no 'typical' journey to STEM, including successful cases of women in STEM who do not have a university education.

The majority of participants considered their journey to be nonlinear and unorthodox. Participants also consider their professional development to be an ongoing, incremental process rather than something contained to university education or early career decisions.

Participants' desire for public role models and workplace communications to promote this reality, and for images of women in STEM to show that re-training, changing career path and learning new skills can be immensely rewarding for women. Participants see STEM as a particularly strong springboard for such messaging, because of the diversity of roles open to people and the flexibility to reskill and move around.

"I didn't go to university. I had a fantastic early start to my career and enjoyed a lot of freedom and growth in other ways. Women can train up and do any role."

Natalie Duffield



"I got into my job by accident. I wanted to be a clinical psychologist at first but then got my first job as a researcher."

Kathrin Cresswell



"With no formal training in technology design, it turns out she [Eishel, daughter & business partner at Sustainably] is extremely good at it."

Loral Quinn



"You don't need to have been coding since you were 5 years old – it's an assumption that is such a hindrance to anyone who's had a different upbringing. I left school at 17 and didn't go straight to university..."

Samantha Rhynas



"I did an undergraduate in Interpreting and Translation at Heriot-Watt University, so I come from a Humanities background... I then become interested in machine translation."

Beatrice Alex



"My background is in teaching, I qualified as an English Teacher as a foreign language in the early 1990s in Poland. My career path was really dictated by the demand of the English language in Business at that time....by 2000 I was managing large IT infrastructure and transformation projects for one of the largest banks in the UK."

Gosia Such



9. We need women in a wide range of roles within an organisation

Although the increased representation of women in STEM was recognised as extremely positive by participants, they often pointed to how the types of job roles women work in are unequal to men's jobs, such as being lower paid and viewed as less prestigious. Participants underlined that these inequalities go unnoticed in the workplace. Employers need to reflect on gendered divisions and gain a more informed view on the workplace cultures that shape women's workloads and experiences of the workplace.

"I've been in a conference room and people have asked me to go and get the coffee not realising I was a participant! This is actually quite a common experience for women that they're assumed to be more junior than they are or in more administrative roles rather than decision-making."

Fiona McNeill



"There is still an often sexist, patriarchal structure in place at university, both conscious and unconscious... especially in positions of power, such as supervisor vs student, where there remain to be issues."

Katie Barker Ward



"As a working Mother in academia, I understand all the extra, unpaid, under-recognised labour women do."

Verena Rieser



"The bar is set higher for you as a woman in the workplace. There is an endemic and systematic layer of sexism that still exists in academia"

Melissa Terras



10. has profound and complex impacts on women

Participants often discussed the emotional, psychological and professional impacts of sexism at work. This personal side can be left out of the picture when discussing issues like representation. Participants were keen to share how sexism in STEM is not only morally and socially problematic, but a cause of complex and long-term stress for women and girls that gives rise to legitimate reasons why

they do not want to enter or stay in STEM. Emotional and psychological harm is also experienced on top of pressure to work 'on par' with male colleagues, showing how women can face more challenges to their confidence and wellbeing in work and education rather than it being the case that they possess less skills, determination or 'natural' confidence.

"There are still a lot of stereotypes...which can be quite damaging. Most of our members have a story about something someone has done or said to them because of their gender. This sort of behaviour can be isolating and makes entering the industry after university even more daunting."

University of Edinburgh Women in STEM society



"If you actually look at what it's like working in tech, it's pretty hostile for women, particularly the gaming industry. It makes women feel like they don't belong. There are a lot of common barriers as well...like women being spoken over and not included. I notice inequalities among students, where male students will react negatively to women's events and women will get stick. Some of that exists at a staff level... it's very hard work being in that constant fight mode. Doing that on top of your career, especially in the face of opposition, is stressful."

Fiona McNeill



"There's still a lot of covert discrimination towards women that isn't always obvious but can have serious effects."

Nayha Sethi



"Data and technology are generally male-dominated industries, and in some organisations that can breed a 'boys-club' culture...making it challenging to create an inclusive team where woman feel equal and empowered."

Elizabeth Hollinger



11. Male allies play an import role and should be part of improving inclusion

Participants often had male role models and colleagues whose support and mentorship relates to their own progression and success, showing the important role of men in STEM gender equality. Participants often shared stories of men who did not hold them to stereotypes, who demonstrated strong leadership around uplifting women, and exercised their privileged position to support gender equality.

"He was such a good supervisor, extremely supportive. I was one of his first female students, and he was towards the end of his career then! There was me and another female student; we were the first female PhD students he had. He was a very thoughtful man and in fact, I think he tended to discriminate in favour of us rather than the other way around."

Rosalind Allen



"I had a wonderful supervisor; he was a great mentor to me. Even now I ask myself 'what would he do in that situation?'"

Kathy Whaler



"My relationship is very equal, I have an extremely active and supportive husband."

Verena Reiser



"In my career, I've never been kept down by a man. Quite the contrary."

Muffy Calder



"One of my heroes is Sir David Carter, previously Regius Professor of Surgery at the University of Edinburgh and Chief Medical Officer. I learned a great deal about how to handle tricky people and meetings from him."

Aileen Keel



12. Gender equality needs to be more than a check box exercise

Participants are often frustrated by the excessive focus on 'getting women and girls in to STEM', which places the burden for change on women and narrows problems to a 'tick-box' exercise. They put forward a number of issues that need to be considered around recruiting and retaining women in STEM that go beyond representation issues and convincing women and girls to study and work in STEM.

"We're often told that we ought to include more women in STEM but often with little consideration as to whether a male-dominated and defined pathway is also right for women and girls."

Ewa Lugar



"I don't think it should be so much about 'convincing' women and girls, but showing all young people what I consider to be the true, creative, and intellectually rewarding aspects of my science, computer science. Then they can make up their own mind."

Muffy Calder



"If you don't have enough people, you won't reach critical mass, which is meant to be around 30%. You end up feeling isolated and facing stereotypes that threaten your performance until you get that critical mass of people, which makes it normal to be a woman in the environment. The other thing in the wake of 'Me Too' is more reports of harassment in the tech industry, sexual harassment and gender discrimination – all kinds of discrimination actually – which is really worrying because it seems like the tech industry might be a particularly unpleasant climate."

Judy Robertson



"I can understand why women don't want to take up senior leadership positions, it needs a lot of work at the moment."

Lesley Yellowlees



13. We all have a responsibility to ensure that our industry is inclusive and that products and services don't perpetuate bias

Whilst participants regard greater inter-disciplinarity as a positive trend, they sometimes cited concern that women will be locked out of a technologised labour market. As all sectors and industries are

becoming STEM-related in some way, ongoing sexism in STEM may mean gender inequality is replicated in technologised workplaces. Participants often highlighted this as an urgent concern for employers to address, particularly as technologisation is evolving so rapidly. The consequences of failing to properly plan for inclusive technologisation is predicted to exacerbate discrimination towards women in STEM, and create sexist, racist and ableist biases in products and services.

"The reality across Scotland in any sector is that it is becoming more technologically advanced and data rich. It's not just traditional technological jobs, it's areas like the health sector as well. We are determined...ensuring that women are not locked out of the jobs of tomorrow. We need women at the heart of the development of STEM to make the field worthy of the future and to ensure women have a place in the evolving and modernising labour force.

"It's about creating innovation that's fit for purpose. Research tells us that because of human bias and largely men creating these technologies, we are embedding bias – literally man to machine – into AI and design. If we can get a more diverse work team creating the technology of tomorrow and the algorithms that inform those, we are less likely to replicate human discrimination and prejudice."

Muffy Calder



"Women often find it difficult to break into these traditionally male-dominated fields at school, university and especially as a returner. The jobs of the future are in STEM, yet there is a skills shortage."

Tracy Steinberg



"'Normal' society shows us how it's actually constructed in ways that frame male needs and the male perspective as universal. That's our biggest challenge – how do we re-design the rules of the game so that gender equality is hardcoded into our daily systems?"

Ewa Lugar



14. Invest in data and AI education

Participants want to see data, tech and AI education and training funded and valued. They see this education as going 'hand-in-hand' with the fourth industrial revolution to ensure an ethical and inclusive future.

“Many of us don’t understand the machines that were built by other humans. Nowadays, even those who build these machines don’t quite understand how they operate as they are built to be autonomous.”

Larissa Pschetz



“We need younger children to understand what data science actually is so they can go on and study it at higher stages. The challenge is how do we create fun, engaging activities that primary teachers see the relevance of but that also happens to involve data!”

Kate Farrell



“It’s fantastic to see the value of data being recognised in the boardroom. A data-driven approach helps remove unconscious bias from decision-making.”

Nuala Kennedy



“It is very important that the development of educational technology is informed by the most up-to-date thinking about bias and ethics. We could spend more time at institutional level thinking about that.”

Melissa Highton



“I do a lot of user-centred design and the idea is that you get the people who are going to use technology to design it with you. You shouldn’t ever get too far from what the users think about it... personas in design sometimes is just sometimes blatant stereotyping... If you’re not careful, you end up with bias, stereotyped portrait of what a 20-something year old male thinks women wants.”

Judy Robertson



Key observations and learnings

With comments from Poppy Gerrard-Abbott

1. STEM women are well-connected and form organic peer support communities, locally and globally

This interconnectedness allowed our campaign to gain in-depth insight in to women's roles across a broad spectrum of sectors and industries, and capture a cross-section of ages, seniority and career stages.

These close-knit networks evidence that women are entering, staying in and rising through STEM ranks. However, it may also reveal that there are limited numbers of women in these areas and that there is a need for support due to the shared challenges they continue to face.

These networks made word-of-mouth and 'snowball' sampling highly suitable recruitment channels for the project, and for future research and role model campaigns. The *Women in Data* project was able to achieve breadth and depth quickly. This did, however, provide challenges around capacity and scope and shows the need for greater funding allocations for gender equality projects.

“What struck me in the interview recruitment process was the interconnectedness of women in workplaces, their willingness to lift up others and recommend them to be interviewed.

My inbox became unmanageable.... working at maximum capacity, we still only interviewed the tip-of-the-iceberg of women who were suggested.”



2. Widespread enthusiasm was expressed across the City Region from university management and staff for women's contributions to STEM to be heard

This could reflect a recognition in our universities and workplaces of the benefits of gender equality and shows that gender equality is a 'hot topic'. However, work needs to continue to ensure that institutions avoid one-off or 'tick-box' projects on gender equality.

3. Women sometimes felt anxious about celebrating their work or were worried that their work was not fitting for the project

This often included concern that they were talking about themselves 'too much' or with a selfish tone in interviews.

"I was moved by... the impact of sexism on participants' perceptions of their skills and their confidence to talk about the profoundness of their work."



4. Participants' opinions differed around the severity of gender inequality in STEM

Their stances are fluid and shaped by multiple factors – their particular area of STEM, their education, and peers. It was also influenced by where they are 'at' in their career. Motherhood and 'second shift' responsibilities – such as care and domestic work on top of paid work – were often cited as reasons for changes in perspective towards more aware or critical stances.

"I was intrigued by disparities between participants' views of the 'women in STEM issue'. This brought up damning views on the scale of sexism in our workplaces, alongside careers that were not particularly touched by gender equality matters. The participants' closeness to feminist issues seemed to be shaped by many things: the level of support received from parents, peers and partners, their familiarity with being the only woman, the prestige of their education and how this shaped perceptions of their own skills, the representation of women in specific disciplines – biology and linguistics, for example, are sciences where women are better represented than physics or chemistry.

Their feminist position would also fluctuate at different career stages, where inequalities could become visualised when women had a child or were made redundant."

5. Among participants who thought that gender inequality is a significant issue, participants still held differing opinions regarding the ‘right approach’

Their ‘strategies’ were shaped by factors like how long they had worked in male-dominated environments, age, seniority, management and relationship with feminist ideas.

“Some opted for a ‘get on with it’ attitude over a critical one – two very different but equally understandable and legitimate approaches to operating in male-dominated environments.”

6. Participants’ opinions differed on what the main problem is when it comes to STEM gender inequality, and where attention should be focused

Participants expressed frustration about initiatives that approach the STEM ‘leaky pipeline’ as solely an issue of recruiting women. Whilst many acknowledge governmental and employer campaigns as important and want these to continue, they are concerned about these approaches being too narrow – and geared to create a ‘smoke and mirrors’ impression of change.

Participants’ beliefs about where change should best occur tipped in different directions. Their approaches can be broadly grouped as ‘institutional change’, which locates the burden for change with schooling and employers, and ‘women’s action’, which argues for women to change their relationship with STEM by acknowledging their abilities and taking up training and education. Many mentioned a third approach of cultural or system change, which calls for more radical, complex cultural shifts around perceptions and treatment of women, including the end of sexist stereotyping in childhood and sexual violence and harassment in workplaces.

“Is it a representation issue, where we need to encourage women and girls to go in to STEM, or do we need STEM itself to change so the fields are fit for women? Whose issue is it exactly? Is discrimination towards women a ‘women’s issue’ or does the legwork rightfully lie elsewhere?”

7. Although the links between the social sciences and STEM may not be obvious, a sociological lens is useful to understanding inequality issues in STEM

Participants, staff at the University of Edinburgh and those who attended the campaign’s launch event commented on the utility of applying sociology to problems in the STEM world.

“With sociological approaches...we can identify hidden biases and understand how inequalities in data and STEM relate to wider inequalities and social hierarchy... with that critical distance that we can pause and deconstruct the mundane in the world around us, like hidden gender biases and discrimination in workplace practices, data sets and technologies.

Sociology...tells me that if the rules and design of the social world were made-up and made-up by certain groups of people, it means that it is perfectly possible for the constructed to be deconstructed, reconstructed and other groups of people to join in knowledge and culture-creating processes.

[Feminist sociology] practises with the very basic principle of legitimising and pulling in other people’s narratives and experiences of the world...incorporating women’s experiences is essential for design innovation that is sustainable and successful.”



8. Projects like Women in Data have potential to explore further issues of gender identity, ableism, ageism, classism, homophobia and racism

Although women in STEM can be connected through shared experiences of discrimination, a challenge to any research or campaign is avoiding ‘women’ as a single unit of experience - this project revealed that STEM women hold vastly different positionalities, experiences, and attitudes.

More research is needed to understand the factors and social characteristics that shape status and differences of experience, in order to better tackle gender equality issues in education and work, whilst also integrating and normalising intersectional frameworks in scientific and technological processes to ensure human sexist, racist and ableist biases are not recycled in AI, robotics and technology.

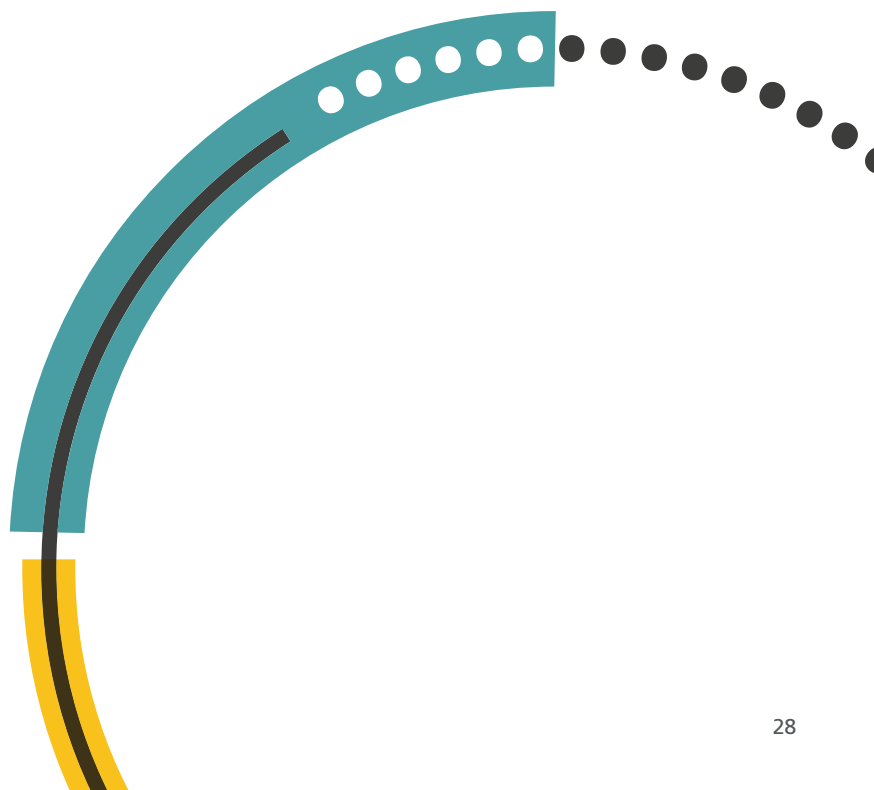
The application of an ‘intersectional feminist’ framework, which looks at the different experiences of womanhood according to social background, ethnicity, disability, race, religion and sexuality, supports the idea that social sciences could continue to integrate with STEM and a sociological lens should be applied more in research.

The *Women in Data* project captured mostly Caucasian participants. Scotland has low numbers of Black people and Minority Ethnic, meaning that the participant pool will have fewer BAME people than a UK-wide study. This is exacerbated by a race gap in STEM, which further stresses a need for studies that pay attention to race and gender in a combined way.

“Looking forward, I’m so excited and impatient to see how we can create better technologies, data sets and urban or workplace infrastructures that meaningfully include not just women, but capture the needs of people with disabilities or transgender, gender fluid and intersex people, acknowledging them as truly legitimate ways of being in the world... recognises multiple ways of being in the world apart from being an able-bodied man – this is just one way of being in the world that has become over-generalised.

This vision is not only urgent and exciting, but it is one that contributes towards an inclusiveness which ultimately reduces violence, harm and suffering.

As awareness grows around the extent of sex, gender, neurological and other forms of diversity, and as we reshape the narratives around disability, we must also intersect these learnings with the fourth industrial revolution. It is with the integration of the social sciences and STEM that we can bring these conversations together.”



Next steps

The Women in Data campaign has been widely shared by the organisations and individuals who took part. The campaign is continuing with support from the Data-Driven Innovation initiative, including but not limited to:

Rolling out the Data Education in Schools programme in City Region schools, helping to tackle to the early source of the IT gender gap

Develop data science course programmes for the region's Colleges which will be ready for delivery to a wide range of learners, including women returners, from April 2020

Continue working to embed equality and diversity across data-driven innovation activities at the University of Edinburgh and Heriot-Watt universities

Pilot a new undergraduate Data Science programme at Edinburgh Napier University, which will be marketed across targeted communities of interest

Let us know what you think

Please feel to email ddi@ed.ac.uk with any comments on this report.

Read the full interviews and press releases from the Women in Data campaign on the [DDI website](#)

With special thanks to our participants:

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|-----------------------|--|--|
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