State of the Art Review

Diversity in R&D and Innovation

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Background

Innovation has a central role in the UK Industrial Strategy (BEIS, 2017) necessitating SME innovation to achieve regional economic development (Roper, 2020). While the masculine constructions of the ideal 'worker' and entrepreneur are well-established (Ahl, 2006; Treanor, Jones and Marlow, 2020); it seems he is also a middle-class, middle-aged, non-disabled, heterosexual white male (Marlow and Martinez-Dy, 2018; Rumens and Ozturk, 2019; Jammaers and Zanoni, 2020). So too, the normative 'scientist' or 'innovator', and their assumed customers or beneficiaries, are male. This has implications for those who do not fit this 'norm', particularly women, or those (including men) with disabilities, or of different ethnic or social class backgrounds, as examples. This awareness has led to a focus on inclusive innovation, which acts as an umbrella term for both focussing upon diversity and the inclusion of under-represented groups as innovators (as per OECD, see Planes-Satorra and Paunov, 2017) in addition to challenging innovators to design products and services for disadvantaged groups to facilitate their social inclusion (Klingler-Vidra, 2018). This review considers research focussed upon the under-representation of, and challenges to inclusion for, individuals of 'other' social categories of belonging.

Evidence

The 'business case' for diversity is said to be strong with diverse organisations reportedly benefitting from improved problem-solving, decision-making, creativity, profitability and innovation (BCG, 2017), and a reported nineteen-percent revenue uplift accruing as a consequence of innovation (BCG, 2018). Innovation is claimed to be positively correlated with an equal gender ratio among teams (Gratton et al., 2007) and women on executive boards result in more competitive firms with above-average profitability and long-term value creation; the latter increases further if ethnic and cultural diversity is also present (McKinsey, 2017). However, there are some conflicting and contradictory results pertaining to diversity within innovative teams, with significant moderating factors such as communication and leadership highlighted (see Garcia, 2018). The negative consequences of a lack of diversity within teams is readily appreciable. Perez (2020)

highlights the recent medical discovery that women's heart attack symptoms differ to those of men, reflecting the unquestioned, assumed male norm among homogeneous, predominantly male, research teams. Similarly, use of only male test-crash dummies until 2012 resulted in women having a 47% greater chance of increased injury from collisions (Perez, 2020). Innovation in the UK often happens within University settings, when academic research breakthroughs are commercialised through spin-out activity, and via innovation-driven entrepreneurship involving entrepreneurial individuals or teams. The evidence in relation to each of these is now considered in turn.

Women are under-represented in innovation and commercialisation activity (Abreu and Grinevich, 2017) and innovation driven entrepreneurship. The latter is said to be a consequence of the 'double masculinity' of science, technology, engineering, mathematical and medical (STEMM) disciplines and entrepreneurial activity (Kuschel, Ettl, Díaz-García and Alsos, 2020). The OECD Science and Technology Report 2017 highlighted that 8.5% of patents in the UK were held by women; more recently, it has been established that only 13% of UK spinouts have a female founder (Griffiths et al., 2020). A "fairly large and statistically significant" (Abreu and Grinevich, 2017: 773) gender gap exists among academic researchers across a range of commercialisation activities including patenting (6.1%), licensing (3.9%) and spinouts (3.2%). Research evidence shows that professors are more likely to be institutionally supported to engage in spinout activity than less senior colleagues (Griffiths et al. (2020). However, women are significantly under-represented within the professoriate due to gendered stereotypes supporting unconscious bias and discriminatory recruitment, selection, and promotion practices that impede career progression (Neumeyer, 2020). Abreu and Grinevich (2017) established that seniority, academic field and level of institutional support combined only accounted for 61% of the gender gap; the remainder was attributed to discrimination and, potentially, other as yet unknown factors.

The recurring issues offered to explain the under-representation of women and minorities in innovative business activities include access to finance, inferior networks and their location (Planes-Satorra and Paunov, 2017; Klingler-Vidra, 2018). While some challenges, such as access to finance, are pertinent for all entrepreneurs and innovators, they will be experienced differently, with different outcomes for individuals from different groups (OECD, 2019). In a recent survey, 56% of BAME entrepreneurs cited lack of finance as a barrier to innovation, the corresponding figure for disabled entrepreneurs was 50% and for white, non-disabled entrepreneurs, 35% (Vorley et al., 2020); this study did not differentiate according to gender.

Securing funding was the identified as the single largest barrier preventing women from entering the UK innovation sector (Klingler-Vidra, 2018: 100). Deep-seated gender stereotypes continue to underpin discrimination among venture capitalists toward women-led businesses (Malmström, Johansson & Wincent, 2017) such that, for every £1 of Venture Capital invested in the UK in 2017, female founders received less than one penny (British Business Bank, 2019). In exploring the combined effects of gender and ethnicity, Black women entrepreneurs in the UK have the lowest median turnover of all ethnic groups; while Asian and other ethnic minorities may enjoy better outcomes than Black entrepreneurs, they too have lower rates of success and return than their White counterparts (British Business Bank, 2020). These issues affect the innovation pipeline, given that under-resourced SMEs will be less likely to invest in R&D and innovation activities (Roper, 2020); these outcomes are attributed to antecedents such as access to finance, educational attainment, deprivation, and a lack of senior management experience in the workplace, in addition to systemic disadvantage (British Business Bank, 2020).

The term diversity, particularly in relation to innovation, has become a metonymy for gender, with ethnicity and disability receiving less research attention (Klingler-Vidra, 2018). In the UK, twenty-three percent of adult women and twenty percent of adult men are disabled (WBG, 2020). Disabled people are a highly heterogeneous group given the range, severity and potential multiplicity of disabilities that individuals can experience, and their differential effects upon ability to undertake everyday activities and to participate in education and the labour market (Kitching, 2014). Research highlights that disabled entrepreneurs experience difficulty in accessing start-up capital (Kitching, 2014) and subsequent growth capital (OECD, 2014) often due to discrimination by funding gatekeepers (Kitching, 2014). Consumer discrimination (Jones and Latreille, 2011) may also affect returns such that future R&D potential is constrained. Financial and educational disadvantages may potentially continue to limit the potential of disabled people to innovate even when they are entrepreneurs (Vorley et al., 2020). It is also possible that disabled innovators may not disclose their status due to the stigmatising effects; consequentially, their invisibility limits opportunities for role-model promotion and mentoring (Vorley et al., 2020) as well as confounding assessment of the extent of under-representation.

Entrepreneurs from ethnic minority or migrant backgrounds also experience discrimination when accessing finance (Ram and Jones, 2008; Neville et al., 2017). However, Hart et al. (2018) highlight that rates of entrepreneurial activity is significantly higher among the non-white UK population (14.5%) than among the white ethnic population (7.9%). The BEIS longitudinal SME study (2018) indicated that 4% of UK SMEs are led by minority ethnic groups and these firms are more likely to be located in innovative sectors such as ICT (8%) than construction (2%) which supports previous findings that ethnic minority innovators have been shown to positively influence patenting activity in the UK (Nathan, 2014). Ethnic minority led SMEs in innovative sectors were more likely to be London-based and owned by Indian men. It is noteworthy that women, older people and individuals identifying as having a disability are significantly under-represented in the UK IT sector (Klingler-Vidra, 2018).

UKRI, the national funding agency investing in science and research in the UK, incorporates the 7 Research Councils, Innovate UK and Research England and has a combined budget of more than £6 bn which it uses to fund research in Universities, by individuals and in businesses. A UKRI (2020) report provided their first ethnicity analysis of research funding applicants and awardees across all of UKRI's research funding channels. White individuals constituted the majority of applicants and awardees, particularly as Principal Investigators (PIs). Ethnic minorities constituted the largest proportions of applicants and awardees in the role of Co-Investigators (CIs), relative to Principal Investigators (PIs) and Fellows, with Asian applicants outnumbering Black and other ethnic minority groups. Chinese academics were over-represented as awardees, relative to their labour market representation and Higher Education Statistics Agency (HESA) staff share, whereas Black and Bangladeshi individuals were relatively under-represented as awardees. Similar analyses on the basis of gender and disability are not available.

However, EPSRC, the Engineering and Physical Sciences Research Council, have taken steps to improve women's representation and access to funding. The EPSRC (2020) gender analysis report highlighted that women comprise 18% of the EPS academic community and 26% of the student population but are under-represented as PIs; only 14% of applications were submitted by women PIs in 2018-19. Although award rates by number are almost equal across genders, funding awards by value show significant disparity. Women are consistently more likely to apply for smaller grants; since 2007 EPSRC received only 5 applications from women PIs for grants in excess of £10 million, in comparison to 80 applications from men as PIs. However, when women do apply for

larger value grants they appear less likely to be awarded that grant. Analysis of costs requested in female-led and male-led applications highlighted a key differential was salary costs; from age 35 onwards male salary costs rose faster and higher than requested female salary costs.

A locus of innovation in the UK is large private sector businesses. In 2019, expenditure on R&D performed by UK businesses equated to £25.9 billion with the largest growth in expenditure occurring in Pharmaceutical firms and related R&D employment standing at 263,000 FT equivalents (ONS, 2020). However, diversity in R&D teams and innovation in this context is also problematic. The International Innovation Barometer 2020 highlights 83% of innovation teams are majority male, this may be underpinned by 46% of business leaders reportedly considering diversity in innovation to be 'unimportant'; in the UK 1 in 5 R&D teams are entirely male (Ayming, 2020). Evaluating diversity in innovation within these large organisations, in terms of ethnicity and disability, is hampered by a lack of transparent reporting (McGregor-Smith, 2017; CIPD, 2019).

While it is a legal requirement that companies in the UK with 250 or more employees report on their gender pay gap every two years, the absence of similar regulatory requirements pertaining to race and ethnicity data (McGregor-Smith review, 2017) and employees with disabilities (Khan et al., 2019) is considered to underpin this lack of reporting. UK companies generally have been poor at collecting workforce diversity data and, even when they have collected data, they neither analysed nor utilised such data effectively (CIPD, 2017).

The UK Government's Consultation exercise on ethnicity pay gap reporting in 2019 increased expectation of ethnicity pay gap reporting being introduced, this prompted preparatory responses. A PWC (2020) report at the end of 2020 highlighted that, despite reported concerns around associated legal and GDPR requirements in the same survey only 9 months earlier, 2 in 3 UK companies are now collecting ethnicity data with almost 50% of companies planning to disclose in the next 3 years. However, most are employing a binary approach to ethnicity data (White/non-White) collection which limits the ability of organisations to understand and respond to the barriers and outcomes experienced by different and intersecting groups, such as between Indian and Bangladeshi men or Indian men and Bangladeshi women (EHRC, 2019). In contrast, collecting ethnicity data according to Census categorisation of ethnicity would facilitate effective diversity monitoring over time and related intervention design for, or promotion to, specific employee groups (CIPD, 2019).

The consultation exercise undertaken on introducing ethnicity pay gap reporting led to calls for a disability focussed counterpart. Again, intersectional analysis of diversity in innovation pertaining to disability would be highly informative. Claims that neurodiverse employees, such as autistic or dyslexic employees, think differently and are more innovative, underpin targeted recruitment by firms such as SAP, Microsoft, Hewlett Packard Enterprise, Dell Technologies, Ford and EY of individuals on the autism spectrum (HBR, 2017; EY, 2019). However, the Westminster AchieveAbility Commission (2018) found 52% of dyslexic individuals in the UK reported experiencing discrimination in recruitment and selection processes. This suggests employees with different disabilities may have very different outcomes and the barriers and effective solutions for employees with specific disabilities would be lost if a binary approach to data collection were adopted.

The introduction of reporting requirements will not guarantee effective organisational policy and practice change nor progress in relation to the representation or outcomes of specific groups. Gender pay gap reporting has not yet remedied differential pay and progression outcomes for women (EHRC, 2019). A transformative effect requires senior

and middle management commitment to diversity and the adoption of evidence-based good practice in tailoring recruitment, training, mentoring and progression policies to enhance diversity in innovation. A necessary precursor to this, however, is good quality people data; ideally, this would be comprehensive and facilitate intersectional analysis enabling tracking of the retention, promotion and pay over time of individuals belonging to different, and different combinations of, protected characteristics[1] (CIPD, 2019). In turn, collating comprehensive and accurate data necessitates collaboration with different employee groupings so they are comfortable disclosing personal information without fear of detriment or repercussion.

Summary and evidence gaps

Further research exploring diversity in innovation that adopts a broader perspective than gender is required. The antecedents of exclusion from the pipeline leading to involvement in innovative activity and entrepreneurship for women, ethnic minorities and other under-represented groups are wicked problems. They are linked, not just to place and regional barriers to support but also, to social class and family background and the influence of these upon experiencing poverty, educational attainment and social mobility, a lack of role models and the influence of bounded rationality upon perceived options that can ensue from experiencing differing combinations of disadvantage and discrimination. Intersectional analyses to explain and contribute to overcoming the under-representation of, and structural inequalities challenging, individuals from different and multiple categories of belonging are, therefore, required (Marlow and Martinez-Dy, 2018; Vorley et al., 2020). However, this must be accompanied by managerial recognition that diversity is important and beneficial, longitudinal research and analyses, and, adopton of a proactive, evidence-based approach to designing effective policies, organisational procedures and initiatives that can improve outcomes for individuals regardless of their categories of social belonging.

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[1] Protected Characteristics under the Equality Act (2010) are: age, disability, sex, sexuality, gender reassignment, race, religion or belief, marriage and civil partnership, pregnancy and maternity.

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