RUNNING HEAD: Open Science in Feminist Early Career Research

Navigating Open Science as Early Career Feminist Researchers

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Citation diversity statement (Zurn et al., 2020)

In this paper, we sought to proactively select references that reflect the diversity of the field in form of contribution, gender, race, and ethnicity. To check for this, we obtained the predicted gender of the first and last author of each reference by using databases that store the probability of a first name being carried by a woman. By this measure (and excluding self-citations to the first and last authors of our current paper), our references contain 54.22% woman(first)/woman(last), 13.25% man/woman, 12.05% woman/man, and 20.48% man/man. This method is limited in that a) names, pronouns, and social media profiles used to construct the databases may not, in every case, be indicative of gender identity and b) it cannot account for intersex, non-binary, or transgender people. We look forward to future work that could help us to better understand how to support equitable practices in science.

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Abstract

Open Science aims to improve the rigour, robustness, and reproducibility of psychological research. Despite resistance from some academics, the Open Science movement has been championed by some Early Career Researchers (ECRs), who have proposed innovative new tools and methods to promote and employ open research principles. Feminist ECRs have much to contribute to this emerging way of doing research. However, they face unique barriers, which may prohibit their full engagement with the Open Science movement. We, ten feminist ECRs in psychology, from a diverse range of academic and personal backgrounds, explore Open Science through a feminist lens, to consider how voice and power may be negotiated in unique ways for ECRs. Taking a critical and intersectional approach, we discuss how feminist early career research may be complemented or challenged by shifts towards Open Science. We also propose how ECRs can act as grassroots changemakers within the context of academic precarity. We identify ways in which Open Science can benefit from feminist epistemology and end with six practical recommendations for feminist ECRs who wish to engage with Open Science practices in their own research.

Navigating Open Science as Early Career Feminist Researchers

In recent years, the Open Science movement has prompted a discipline-wide reappraisal of the reproducibility, replicability, and robustness of psychological science (Nosek et al., 2015; Open Science Collaboration, 2015). Although uptake of Open Science methods throughout psychology has been slow (Norris & O'Connor, 2019), many Early Career Researchers (ECRs) have responded to this changing landscape with enthusiasm and innovation (Bartlett & Eaves, 2019; Farnham et al., 2017; Hobson, 2019; Orben, 2019). Here, we define Open Science as both the commitment of incorporating transparency in all aspects of the research process, and a fundamental approach to research which aims to clear science of its ideological biases. There has been a notable lack of consideration for how Open Science, as both a practical and philosophical approach to doing science (Fecher & Friesike, 2014), may complement or indeed contradict early career work with a feminist agenda.

We write as a collective of ten early career psychologists, comprising eight PhD researchers, one post-doctoral researcher, and one early career lecturer. We all identify as feminist researchers and women, both of which informs the lens through which this paper examines the phenomenon of Open Science. While our personal feminist goals and objectives may differ, being in the collective early career stage of academia means that we share a distinct set of experiences and viewpoints, which are incorporated throughout this paper. We recognize that no struggle is a "single-issue" (e.g., Lorde, 1984); therefore, we do not assert that our experiences are homogenous, but agree that we share a marginal position as both feminists and ECRs, while also belonging to diverse identities of race, ethnicity, age, language, sexuality, ability, and geographical location. Despite our marginalization in some academic domains, we also recognize that our affiliation and funding from universities places us in a place of privilege, which provides us with the "seat at the table" to consider the issues outlined in this paper.

To understand the lived experiences of a collective, it is important to acknowledge the asymmetric power relations inherent to social dynamics (Søndergaard, 2005). This is aligned with Billet's (2009) notion of "personal epistemologies", denoting a process through which we appreciate how our academic and professional identities intersect to shape who we are within and beyond the academy. We each adopt a personal epistemological approach here, collectively reflecting on what Open Science can offer to early career femininst psychologists, and the potential roadblocks to participation in the movement for open science. The term "early career" in psychology has no clear-cut definition (Breeze & Taylor, 2020). The British Psychological Society refers to an ECR as anyone who has completed their doctoral degree within the past eight years, whereas American Psychological Association ECR award criteria extend this to ten years post-doctorate. In contrast, we take a more holistic approach to this term, and broadly define ECRs as those who are affected, susceptible to, or inhibited by academic precarity (Bosanquet et al., 2017).

Feminism and Early Career Open Science

Each author of this paper identifies as a feminist scholar; however, the meaning of the term "feminist" varies slightly for each of us, depending on our unique epistemological, ontological, and methodological objectives. Feminist psychology grew out of an initiative to combat social myths and stereotypes about the roles of women in society (Shields, 1975), rapidly changing and expanding to diversify and restructure psychological science as a whole (Eagly et al., 2012). For some, identifying as a feminist scholar means that one's research aims to shed light on the gendered experiences faced by women. For others, their feminist agenda centres on reconsidering approaches to research as a whole, questioning colonial and patriarchal assumptions about the very nature of knowledge, science, and accessibility. Just as feminist psychologists have prompted us to consider the questions that we ask (Rutherford, 2007), and to "inquire about how we inquire" (Ackerly, & True, 2008, p. 695; Dahlberg &

Dahlberg, 2020), Open Science also encourages us to adopt a more critical and transparent approach by reappraising current academic practices (Aspendorpf et al., 2013; Shrout & Rodgers, 2018). Thus, the core principles of Open Science are arguably aligned with feminist values, in that the movement ultimately aims to challenge ideological biases and re-imagine the way that power is distributed and governed (e.g., Allen & Mehler, 2019).

Before we discuss the opportunities and challenges specific to interacting with Open Science as feminist ECRs, it is vital that we recognise the unique perspective that ECRs occupy in the contemporary university. Academia exists within a climate of neoliberalism and precariousness (Davies & Petersen, 2005; Tynan & Garbett, 2007), which disproportionately affects early career women (Reay, 2000; Thwaites & Pressland, 2017). Due to a scarcity of jobs, particularly jobs with permanent contracts, there is an intense culture of competition and hierarchy in the ivory tower (Caretta et al., 2018). This is largely, and historically, dominated by White, male, middle-class voices, and ideological hegemony remains a dominant component of perceived scholarly aptitude (Margolis & Romero, 1998; Read et al., 2003), meaning that women face unique barriers to participation (Gruber et al., 2020).

Open Science tools and resources that aim to destabilize power, promote collaboration, redistribute opportunity, and improve the transparency of research may be specifically beneficial for feminist ECRs as they navigate academia. However, currently, understandings of feminist ECRs' engagement with the Open Science movement is not well mapped out. The distinct lack of gender disaggregated data in Open Science practice suggests that most analysis and policy documents in this field adopt a gender-blind approach, whereby gender equality and Open Science are treated as independent topics (GenderAction, 2018). This approach reflects the devaluing of gender equitable provision, contributes to systemic bias and prejudice, and hinders opportunities for effective policy development. To unpick

some of the tensions that exist in feminist ECRs engagement with Open Science, we first outline some of the benefits of Open Science tools, before highlighting unique challenges for feminist early career researchers.

Benefits of Open Science for Feminist ECRs

Although not every hiring committee is equally open and appreciative of Open Science methods (see Bahlai et al., 2019), Open Science has the potential to be beneficial for ECRs' professional development (Markowetz, 2015), particularly many committees' over-reliance on quantifiable metrics as a measure of performance and employability, such as publication count (Gruber et al., 2020; Thwaites & Pressland, 2017). For example, ECRs experience pressure to publish in prestigious journals to meet the demands of academic job criteria (Siegel & LaMarre, 2019). Given these ongoing challenges, Open Science tools offer practical benefits for ECRs; for example, open access publications , open data, code, and materials), preprints (Sarabipour et al., 2019), and registered reports are associated with increased citation rates (Hobson, 2019; Piwowar & Vision, 2013; Pontika, 2015; Sarabipour et al., 2019). Many of these tools are considered scientific outputs with their own Digital Object Identifiers, which can help ECRs to establish their scholarly reputation, improve academic curriculum vitaes, and increase employability (Aarts, 2017; Markowetz, 2015; O'Carroll et al., 2017).

Open Science practices have the potential to buffer against some of the gendered inequalities present in academia. For example, open access publishing can mitigate the gender citation advantage, whereby men receive more citations (Aksnes et al., 2011; Odic & Wojcik, 2020). Moreover, improper credit allocation can exacerbate existing power imbalances in academia (Street et al., 2010; Van den Eynden et al., 2016). Women are less likely than men to be senior authors on scholarly publications (Odic & Wojcik, 2020), and ECRs report experiences of others taking credit for their work (Wellcome Trust, 2020).

Novel open research initiatives such as the Contributor Roles Taxonomy (CRediT; Allen et al., 2019), can empower ECRs to transparently take proper credit for their work and obtain appropriate and deserved recognition (Schmidt et al., 2018). Therefore, attempts at levelling the playing field through Open Science culture shifts (Munafò et al., 2017) are particularly useful for ECRs who may not have access to the inside knowledge (or the "hidden curriculum") of academia (Reay, 2004).

The practical benefits of Open Science for feminist ECRs are likely to build, as funders, journals, and stakeholders begin to exert top-down pressure for implementing Open Science practices. This is evidenced in initiatives such as *Coalition S* and *Plan S* (Schiltz, 2018), the Leiden Manifesto (Hicks et al., 2015), *TOP* guidelines (Nosek et al., 2017), and *UK Reproducibility Network* (Munafò et al., 2020). Moreover, open research as a criterion in hiring and promotion will increase the competitive advantage that ECRs who adopt Open Science practices have over those who do not (Kowalczyk et al., 2020). This can make a vital difference for ECRs, particularly for those from traditionally marginalized and underrepresented groups in academia, by ensuring that the work involved in this research is highlighted and appropriately credited, In essence, Open Science may allow feminist ECRs to further the reach and accessibility of their research, which can have practical benefits for ECRs as they grapple with establishing a scholarly reputation.

Barriers to Participation in Open Science as a Feminist ECR

While some of the emergent tools within the Open Science movement are useful in overcoming systemic and practical problems within academia, there are undoubtedly unique challenges that feminist ECRs face in this arena. For example, a recent conference poster by Koyama and Page-Gould (2020) provides a useful synthesis of ECRs' concerns about implementing Open Science practices into their work; most notably, fear of persecution, insecurities, and social dynamics that exist within scientific publishing. Importantly, the

authors also note that a barrier to participation in Open Science is the perception of "limited discussion about [...] whose participation is valued". This notion is echoed in the Open and Collaborative Science in Development Network's manifesto (Open Collaborative Science in Development Network, 2017), which also calls into question whose voice is regarded as important in science. Given that early-career voices are often the least valued in research spheres, their attempts to contribute to Open Science may be regarded as trivial or unimportant (Vargo, 2017).

Open Science practices are commonly associated with restrictions on flexibility and a burden on time (Allen & Mehler, 2019). While some have argued for the benefits of "slow science" (Frith, 2020; Siegel & LaMarre, 2019), current hiring criteria and grant committees still celebrate the quantity of academic publications over the evidence for Open Science practices in their work (Kowalczyk et al., 2020). Until the necessary slow shift in conventions takes place, feminist ECRs engaging in Open Science practices will be particularly disadvantaged by allotting additional time to the feminist practices outlined in the Open Collaborative Science in Development Network (OCSDNet) Manifesto: knowledge commons, cognitive justice, situated openness, research participation, equitable collaboration, inclusive infrastructures, and sustainable development (Albornoz & Chan, 2017). Similarly, if there are restrictions on the types of research available through the *Open Science Framework*, due to sensitivity concerns, safeguarding participants, confidentiality of data, and hiring committees' focus primarily on projects that cannot be open, feminist ECRs may be further slowed down or constrained.

Feminist Research as a Marginalized Area

For all areas of psychology to participate equally in Open Science, all areas of psychology should be considered equal to begin with. However, the principles and practices of feminist psychology have historically been marginalized from mainstream psychology

(MacArthur & Shields, 2014; Rutherford et al., 2010). This is an issue particularly pertinent to ECRs in this field, who have a less established sense of voice and are, therefore, less equipped to destabilize mainstream norms of research (Macoun, & Miller, 2014). This leads to ongoing grapples of power as conservative academics attempt to maintain the status quo and silence or minimise the efforts of younger, more critical feminist research. Feminist epistemology is often regarded as less "scientific" as other, more mainstream or positivist modes of research epistemology is often regarded as less "scientific" as other, more mainstream or positivist modes of research Among other reasons, this may be Among other reasons, this may be due to the potentially disruptive or "socially transformative" nature of feminist voices in psychology (Flick, 2015; Wigginton & LaFrance, 2019). Indeed, in many ways, in many ways, feminist psychologists must fight to be heard (Wilkinson, 1996, 1997). Due to the history of silencing, coupled with the precariousness of early career positions in academia, it is imperative that Open Science remains sensitive to these issues and challenges encountered by feminist ECRs (Thwaites & Pressland, 2017).

Making mistakes in Open Science processes, such as during the preregistration procedure, are likely to "normalize the humanness of research" and thus improve confidence in the research process (Kathawalla et al., 2020, p. 21). However, given the precarity of the academic job market, routine mistakes and errors made through the learning process of open science may result in adverse reputational and personal consequences for feminist researchers and those in the early stages of their careers (Allen & Mehler, 2019). Research that stems from a feminist perspective is more readily scrunitized compared to research that fits more neatly into the "masculinist scientific culture" of methodologies (Young & Hegarty, 2019, p. 454). While feminist is not, in itself, a dirty word, being considered a "feminist" may challenge ECRs' career prospects, given that the label of "feminist" is associated with negative stereotypes (Anderson, 2015). Those who are regarded as both a "feminist" and an

"open scientist" -- particularly in an academic landscape which is still hesitant to fully endorse open practices and predominantly shaped by patriarchal structures (Gruber et al., 2020; Spichtinger, 2020) -- this could pose a significant threat to the mainstreaming of feminist psychology while also hindering progress with integrating feminist thoughts into the Open Science movement.

Open Science in Qualitative Early Career Research

If feminist psychology as a discipline is marginalized, feminist qualitative work in Open Science is likely to experience this in a heightened way. Qualitative methodology holds unique potential to ask, address, and analyze feminist research questions (Eagly & Riger, 2014; Gergen, 2008). The majority of Open Science practices have been developed for quantitative research. Indeed, this argument has reignited long-standing debates about the use of *positivist* evaluation criteria, which is concerned solely with that which is objective, verifiable and measurable, for judging the quality of qualitative research (Smith & McGannon, 2018). Therefore, qualitative research may be in opposition to the current Open Science paradigm, which could further exacerbate the marginalization of qualitative feminist ECRs who already challenge the status quo.

The popularization of a positivist Open Science framework has direct ramifications for qualitative ECRs. The principles of open data do not translate well to qualitative approaches, due to enhanced ethical issues such as increased risk of participant identification (Chauvette et al., 2019) and challenges relating to data ownership (Branney et al., 2019). If ECRs' qualitative research does not fit within an Open Science framework, their career outcomes may be adversely impacted and their work regarded as less rigorous and consequently less publishable (Siegel & LaMarre, 2019). This is particularly true for scholars whose work focuses on vulnerable populations (e.g., children, women who do sex work, individuals in prisons), who may be unable or unwilling to make participant data available

due to safety or legal concerns. Reporting of analytic processes within qualitative research is often vague, with some researchers advocating for increased transparency of these processes (Tuval-Mashiach, 2017). In turn, vague reporting can make it difficult for ECRs to learn how to conduct their own qualitative projects (Hunt et al., 2009). Moreover, researchers have found that women tend to be over-represented as authors of published qualitative studies (Plowman & Smith, 2011). Thus, current approaches to Open Science may disproportionately disadvantage women ECRs working in this space.

Additionally, given that qualitative methodologies are more emergent compared with other methods, ECRs in this space must establish their own networks and communities. To add to this, established researchers have spoken of the territorialism of qualitative researchers, whereby anything that falls outside of what is considered qualitative research provokes a strong reaction (e.g. Braun & Clarke, 2019). Therefore, qualitative feminist ECRs interested in Open Science practices may be particularly vulnerable within the qualitative research community by questioning established methods and assumptions. As well as pedagogic improvement, support for qualitative feminist ECRs in Open Science is urgently needed to improve ECRs sense of belonging in academia (McAlpine et al., 2014).

Despite these challenges, adopting Open Science practices also has the potential to benefit qualitative ECRs. By providing concrete examples of how research develops, preregistration and ongoing documentation of qualitative projects may strongly increase transparency and encourage knowledge exchange (Branney et al., 2019; Haven & van Grootel, 2019). For example, Tsai et al. (2016) suggest that qualitative researchers could make transcription rules, coding units, and processes for code development available. This may balance ownership of knowledge within academia, by providing ECRs with access to information that is often concealed in the reporting of qualitative research.

Vulnerability, Wellbeing, and Invisible Labour

There are barriers to feminist ECRs' personal wellbeing in Open Science spaces. For example, overwork and high levels of occupational stress result in unattainable expectations being placed on ECRs (Allmer, 2018; Pitt & Mewburn, 2016). For some ECRs, transparency can highlight and amplify the vulnerabilities imposed by Open Science (Pownall, 2020). Open peer review can also highlight and exacerbate power imbalances (e.g., retaliation from senior academics for critical reviews). Given that feminist psychology typically centres and celebrates vulnerability (England, 1994; Griffin, 2012), these concerns are likely enhanced in ECR work stemming from this perspective.

A further barrier to engagement with Open Science as a feminist ECR is a culture of increasingly abrasive and competitive online debate, colloquially referred to as "#bropenscience" (e.g., Whitaker & Guest, 2020). "Bropen Science" demonstrates how Open Science spaces are typically governed by white, male, Western values and voices. As Derksen (2019) highlights, this hyper-patriarchal discourse largely disadvantages minority groups. A prominent example of escalated scientific critique can be seen in the case of Andrew Gelman's criticism of Dr. Amy Cuddy's work on the effect of "power poses", which sparked debate among Open Science advocates on how to best constructively criticize science, maintaining a balance between scientific critique and bullying (Dominus, 2017). As an established, tenured researcher, Dr. Cuddy's career was able to recover from this, but this is far less likely for an ECR with a less-established scholarly reputation.

Further, there is a vast amount of invisible labour involved in the promotion, adoption, and engagement with Open Science practices (Social Sciences Feminist Network Research Interest Group, 2017). For example, the UK *Athena SWAN charter has* been criticized for placing the burden and responsibility of gender equality upon "women and other marginalized groups" (Tzanakou & Pearce, 2019, p. 1191). Similarly, ECRs typically

contribute undervalued and under-rewarded ‘housekeeping’ tasks of practices, such as science communication, contributing to open educational resources, volunteering in administration, and serving on committees (Bird et al., 2004). This issue is exacerbated in motherhood (Hunter & Leahey, 2010; Viglione, 2020) and amplified by existing racial disparities of invisible labour (Roberson, 2020).

Feminist ECRs as Open Science Changemakers

ECRs reflect an innovative and dynamic new wave pool of global talent who have the potential to bring about disruptive change (Friesenhahn & Beaudry, 2014; Nicholas et al., 2019). Throughout Open Science conversations, ECRs have challenged established norms within academia and made important bottom-up changes. Despite the precariousness of early career academia, there are “pockets of agency” that exist for early career feminists (Budge, 2014). ECRs constitute the highest proportion of researchers in higher education (Jones, 2014) and ECR-led initiatives build upon decades of work by other feminist researchers in psychology who challenged the status quo in science (see Schiebinger, 2000). Currently, much of the Open Science movement has been championed by grass-roots advocates and self-organized communities of ECRs (Pownall, 2020), such as the international Open Science journal club, *ReproducibiliTea* (Orben, 2019). In recent years, visionary ECRs have serviced the Open Science movement by collating reading lists (Crüwell et al., 2019), curating how-to guides (Etz et al., 2018; Kathawalla et al., 2020; Klein et al., 2018), distributing open research resources (e.g., *Open Research Calendar* and *RIOT Science Club*), and organizing Open Science conferences (e.g., *King’s Open Research Conference 2020*).

The contribution that ECRs make to the advancement of knowledge is vast (Hamilton & Pinnegar, 1998) and grass-roots bottom-up ECR-led initiatives can prompt “a cascade of sustained change” (Garvis, 2014, p. 20) in the academic discipline. By working collaboratively, as is often the case in Open Science research (Murphy et al., 2020). ECRs

can resist occupying marginalized spaces which do not fit neatly within academic moulds or regulations (Fitzgerald, 2014), thus allowing space to reappraise and reimagine the tensions and challenges of academia (Bassett & Marshall, 1998). Indeed, shared experiences of inequality within academia can serve as an "emancipatory process" (Mavin & Bryans, 2002, p. 248) by forging collaboration, togetherness, excellence, and innovation (Nielsen et al., 2018). It is the use of collaboration which has led to the creation of these ECRs initiatives in Open Science.

Collaboration and Collegiality

Community, collegiality, and collaboration are hallmarks of the feminist agenda (Lorde, 1984). Feminist research values cross-career collaboration in the form of mentorship, support and supervision of junior colleagues (Acker & Wagner, 2019), as well as friendship (Kaeppel et al., 2020). Collaboration is also a cornerstone of Open Science (e.g. Open Science Collaboration, 2015), whereby rigorous and transparent science is made possible due to international and cross-disciplinary collaboration. Importantly, collaborating with diverse groups in the context of Open Science can dismantle the gate-keeping and exclusivity of mainstream academia (Burns et al., 2003; Fischhoff, 2013; Jucan & Jucan, 2014), given that collaboration is so broadly defined (Dai et al., 2018; Hormia-Poutanen & Forsström, 2016) and thus encompasses a wide range of perspectives (Nicholas et al., 2019). In this context, working collaboratively can extend the possibility of research and subsequently aid career advancement (Heffernan, 2020).

Open and collaborative science should foster unbiased and fair collaboration between scientists, enable co-creation, and make room for social innovation in society (see Table 1). Women's participation is less constrained in Open Science spaces than in other arenas of academia (Murphy et al., 2020). However, ECRs' capacity for collaboration is closely governed by supervisors and senior colleagues (Kathawalla et al., 2020), who may not (fully)

endorse Open Science practices (Allen & Mehler, 2019). Feminist ECR engagement in collaboration is also embedded in a context of intense competition for grants and job security (Levecque et al., 2017). This means that collaboration is often institutionally unrecognized and unrewarded (Breeze & Taylor, 2020) and ECRs are inherently incentivized to "engage in competition rather than collaboration" (Gill & Donaghue, 2016, p. 93). Consequently, ECRs are forced to make career choices that inherently support this established system, thus creating a vicious cycle.

There are also benefits to wellbeing for ECRs who collaborate. Collaboration can buffer against competitiveness (Breeze & Taylor, 2020), foster a healthy work environment and offer critical political resources for feminist ECRs, especially within increasingly competitive and corporatized university environments (Macoun & Miller, 2014). In turn, this can drastically improve ECRs' wellbeing. For example, Macoun and Miller (2014) reported that a collaborative feminist reading group provided ECRs with an environment of support and belonging, as well as an informal space to extend disciplinary knowledge, develop one's academic skillset, and enable the transmission of cultural and social capital. In order to embed collaboration and collegiality in Open Science, the movement should focus on creating accessible and usable infrastructures for all agents (Alejandra, 2018), and challenging existing claims of objectivity and universality (Okune et al., 2018).

Reimagining Open Science for feminist ECRs

Given that Open Science is an emergent movement within psychological science and beyond, there is scope to reimagine and redefine its aims and goals in a way that represents the concerns discussed throughout this paper. Therefore, it is useful to consider what Open Science, and particularly one that responds to the barriers and benefits to feminist ECRs, and particularly one that responds to the barriers and benefits to feminist ECRs, could look like.

Ultimately, Open Science should work to distribute power more equally and democratize knowledge-making (Spates, 2012) and thus ECRs should re-examine past practices to demonstrate awareness of the cultural biases which reinforce unequal power structures in Open Science, so as not to perpetuate Eurocentric discourse and enforce the social values that (re)create power imbalances (Spates, 2012). In this context, before encouraging openness as a status-quo in psychological science, we must consider what else is being "opened up" in the process and who governs this process (Bahlai et al., 2019). Black feminist thought offers an exemplary epistemological framework which challenges the white, cis-gendered, heteronormative, and able-bodied discourse that ascribes power to knowledge produced within this rhetoric (Alinia, 2015). ECRs using the practices of Open Science should adopt a Black feminist approach to explore diverse feminist epistemologies which can help unpick dominant ideals.

It is important to consider Open Science and feminist research from multiple vantage points and perspectives. Some ECRs are further marginalized by geographical location. For example, in sharp contrast to Western practices, ECRs in the Global South face unique challenges when navigating the world of Open Science (Lebel & McLean, 2018; Nobes & Harris, 2019). For instance, data sharing is limited due to a lack of structural and systemic incentives that promote sharing (Serwadda et al., 2018). In Argentina, social movement activists prefer not to engage in data sharing due to fear of political persecution (Open Collaborative Science in Development Network, 2017). Other barriers include access to resources and capital that promotes Open Science. Moreover, barriers to publication charges may be even more pronounced in the Global South; a study on ECRs in the Global South found that only 14% of the 181 respondents received a fee waiver, whereas 60% reported they paid the fee out of pocket (Nobes & Harris, 2019).

As a research community, we have yet to develop a knowledge infrastructure which truly exemplifies equality and comprehensiveness, to allow for equitable participation (Okune et al., 2018). Inclusive knowledge infrastructures enable diverse agents to participate and collaborate in research processes by means of open platforms, networks, tools and resources (see Table 1). Such virtual infrastructures acknowledge and readdress power relations, increase in-group collegiality, and are thus, specifically beneficial to ECRs (Gardiner, 2005; Okune et al., 2018). However, there is an underlying assumption that once open digital infrastructures become available, that they will be adopted worldwide, or that researchers will be able to participate in the scientific process. Although online collaboration can help to dismantle the barriers to participation that ECRs in the Global South face (Iyandemye & Thomas, 2019), issues such as technological accessibility, create difficulties for women in developing countries (Gillward, 2018).

In essence, an "Open Science" that benefits feminist ECRs should respond sensitively to the concerns raised throughout this discussion. It should champion early-career voices, acknowledge the systemic marginalization that feminist ECRs face, and dismantle the hierarchies that pervade mainstream academia. This can begin by expanding the use of core Open Science tools that are at ECRs' current disposal, such as more transparent ways of publishing (e.g. Registered Reports, preprints, Open Access papers), innovative ways of fostering collaboration (e.g. MultiLab Collaborations, Open Science Framework), and methods to improve ownership and recognition (e.g. CReDiT, Open Data). An ideal Open Science would also have a wellbeing agenda, particularly given that graduate students, who occupy early-career status, are more than six times as likely to experience anxiety and depression compared to the general population (Evans et al., 2018). These issues are particularly prevalent in marginalized groups, such as women (Levecque et al., 2017). However, Open Science should also work to expand the inclusivity and diversity of people

who represent the "movement", unravelling the #bropenscience discourse that has previously left feminist ECRs feeling unable, or undeserving, of participation.

Six recommendations for Feminist ECRs Engaging with Open Science

Inspired by other scholars who have evaluated research from a critical feminist perspective (Fine, 2011; Stainton-Rogers, *forthcoming*), we end our discussion of navigating Open Science as feminist ECRs with six concrete recommendations for fellow feminist ECRs to advance understanding and experiences in Open Science.

1. ***Start at your own pace***

An all-or-nothing approach to Open Science is not the only way to participate; fear of making wrong decisions should not keep you from wanting to implement open and reproducible research practices. Starting out in Open Science can be daunting for many ECRs, as there are multiple options and resources available, but it is important to start in a way that feels comfortable for you. Open Science should not be static, but a flexible learning process that adapts to its users.

2. ***Do what you need to survive***

We need to acknowledge our own limitations; work with what you have available and prioritise your own personal wellbeing. Engagement in (Open) Science can require a substantial level of inside knowledge, connections, and resources. These resources can be both physical or economical (e.g., access to funding and equipment) as well as pastoral or related to personal care (e.g., receiving adequate support from supervisors or senior academics). There are unique cultural, social, and personal reasons that may create barriers to participation in Open Science, which often requires concessions at these early career stages.

3. ***Engage in research advocacy***

ECRs can be powerful Open Science changemakers, demonstrating a voice which can empower others. Questioning the current system is good, but challenging it is better. ECRs

are often reluctant to implement Open Science practices for fear of it impacting negatively upon their career progression, although this is not a universal experience. However, as academia begins to embrace open research, we anticipate more ECRs becoming the voice of change in their respective departments, research groups, or even institutions, and promoting Open Science for future generations of scientists.

4. ***Be as open as possible***

To promote inclusive and accessible Open Science, ECRs should consider whose story is centred in their research, and who is credited for this knowledge production (Dyer & Ivens, 2020). Further, methodology sections should clarify *where, why,* and *how* knowledge is produced during the research (Allen & Mehler, 2019; Dyer & Ivens, 2020). There may be cases when it is not appropriate to participate in open practices, such as publicly sharing data, but a helpful way to view data is that it should be "as open as possible, as closed as necessary" (European Commission, 2016).

5. ***Find (or create) your community***

Community is an important tool for feminist ECRs. This may entail social spaces at your institution, engagement in networks or postgraduate hubs, or online networking spaces. Twitter remains a powerful networking tool for academics and has the capacity to forge meaningful, supportive, and productive relationships between ECRs. In fact, the authors of this paper established this collaboration on Twitter. If you cannot find or gain access to a community, consider creating one.

6. ***Consider alternative and diverse mentorship***

Supervision and mentorship are key to positive ECR wellbeing, health, and success in academia and have potential to mould ECRs' emerging perspectives, beliefs and behaviors. It is important to find a mentor who supports your ideas and principles, and you should not be afraid to look beyond your institution or the academy itself.

Conclusion

Together, feminism and Open Science can collectively challenge the historical domination of Western-centric and heteropatriarchal approaches to knowledge. Researchers should not adopt a one-size-fits all approach to Open Science (Hillyer et al., 2017). Instead, they should aim to be more inclusive of different approaches to science, including that which stem from feminist epistemology. There have been efforts to adapt Open Science practices to alternative research methodologies (Haven & van Grootel, 2019; Kern & Gleditsch, 2017; Tsai et al., 2016); however, as feminist ECRs occupy a precarious and marginal position, their voices should be centred in the development of emergent Open Science tools. Open Science should further welcome marginalized communities to unpick what the Open Science movement means for them, so that ECRs know how not to be complicit with the silencing, devaluing, or marginalizing of others.

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Supplementary information

In the following table, we list links and resources, referred to throughout the paper, in alphabetical order.

Table 1. Open Science resources with links.

Resource	Link
EU Horizon GenderAction Policy briefing	GenderAction. (2018, July 5). Gender in Open Science and Open Innovation: https://genderaction.eu/wp-content/uploads/2018/07/GENDERACTION_PolicyBrief5_Gender-OSOI.pdf
GitHub	https://github.com/
Human Connectome Project	http://www.humanconnectomeproject.org/
King's Open Research Conference 2020	Event: https://www.kcl.ac.uk/events/kings-open-research-conference Program: https://docs.google.com/document/d/1qdIkRPVn6aXpjWV2bc_PGmGyrE-0ACEyMc_w7vrnZpk/edit
Open Collaborative Science in Development Network (OCSDNet)	OCSDNet Open Science Manifesto: https://ocsdnet.org/manifesto/open-science-manifesto/ OCSDNet (2015). Open, Collaborative and Alternative Science: overcoming health, inclusion and environmental challenges in Argentina: http://ocsdnet.org/wp-content/uploads/2015/04/48eb7ed0c2cbf326ba02eeb9fe97c4af.pdf OCSDNet (2017). Open and Collaborative Science: Using Knowledge as a Pathway to Sustainable Development: https://ocsdnet.org/open-and-collaborative-science-using-knowledge-as-a-pathway-to-sustainable-development/
Open Research Calendar	https://openresearchcalendar.github.io/Open-Research-Calendar/
Open Science Framework	https://osf.io/
ReproducibiliTea	https://reproducibilitea.org/

RIOT Science Club	http://riotscience.co.uk/

Note. All resource links were last accessed on 03.10.2020.