



ARTICLE

<https://doi.org/10.1057/s41599-022-01160-1>

OPEN

 Check for updates

Producing knowledge in a pandemic: Accounts from UK-based postdoctoral biomedical scientists of undertaking research during the COVID-19 pandemic

Jamie Beverstock¹ & Martyn Pickersgill¹  ¹✉

While far from the first pandemic to impact knowledge-production, the widely constructed singularity of the biosocial ramifications of the SARS-CoV-2 virus has produced a set of epistemic and social circumstances that are experienced by many as unique. In relation to biomedical research these include the reworking of the social, spatial, and temporal organisation of science through lab closures and social distancing requirements. Drawing on a small number of qualitative interviews rapidly conducted during a 2021 'lockdown', this exploratory article reflects on how COVID-19 has shaped the research of postdoctoral UK-based biomedical scientists. We consider: (a) how challenges are constructed and negotiated, and (b) in relation to these, scientists' account of why researchers might (not) 'pivot' towards COVID-19. Accordingly, this paper indicates how the experiential conditions stimulated by the pandemic interact with pre-existing professional discourses within biomedical science—e.g., in relation to funding and career strategy—to inform and delimit knowledge-production, and to substantiate particular practices. We suggest some of the ways in which future studies might develop our provisional findings to cast new light on the effects of the pandemic on biomedicine, as well as on the entangled social, economic, and epistemic dynamics of science more generally.

¹ Edinburgh Medical School, University of Edinburgh, Edinburgh, UK. ✉email: martyn.pickersgill@ed.ac.uk

Introduction

Since the emergence of the SARS-CoV-2 virus, many individual scientists, funding bodies, and scientific journals have turned—or ‘pivoted’, in the argot of universities—towards the study of COVID-19. Simultaneously the pandemic has produced major disruptions, reworking the social, spatial, and temporal organisation of research with lab closures and social distancing requirements. This exploratory paper, situated within science and technology studies (STS), seeks to contribute to discussions about the impact of COVID-19 on biomedical science. It does so through interviews with a small number of early-career researchers: a group widely understood to be particularly impacted by the pandemic. The article considers how knowledge production occurs under the social conditions associated with SARS-CoV-2, and explores scientists’ accounts of why and how researchers might (not) pursue studies of COVID-19. These relate to pre-existing professional discourses and practices within science—in relation to, for instance, funding and career strategy (de Rijcke et al., 2016; Fochler, 2016; Gläser and Velarde, 2018; Müller, 2014a)—which justify a range of responses to the pandemic, and potentially limit the production of knowledge about it.

Biomedicine and the pandemic

In June 2020, the high-profile science journal *Nature* described what many academics were seeing in practice: a range of researchers were switching from an array of fields—including beyond biomedicine and public health, such as high energy physics—to publishing on COVID-19 (Gibney, 2020). A variety of journals have oriented towards COVID-19, with reductions in the number of non-COVID papers being published in major medical journals (Giustini et al., 2021). Various funders have also had special schemes for research into COVID-19. Such shifts have been informally termed ‘COVIDization’ (Pai, 2020).

The practical aspects of biomedical knowledge production have likewise been impacted by the pandemic. As Johnson et al. (2021) found in their survey of US scientists, there have been disruptions to lab work and collaborations, loss of data and animals, and a range of other issues (Walker et al.’s (2022) survey study with business, economics and management researchers likewise indicates a range of impacts on scholars). Commentaries in *Nature*, again, as well as other periodicals, have also cast light on some of the difficulties researchers have faced in performing experiments (Woolston, 2020), and maintaining required materials, such as animal populations, cell lines and tissue cultures (Madhusoodanan, 2020). For many, particularly early career researchers, this has resulted in increased pressures. *Nature*’s survey of 7670 postdoctoral scientists found that eight in ten experienced significant disruptions to experimental work, and nearly two thirds felt that the pandemic had negatively impacted their career prospects (Woolston, 2020; see also Yan, 2020).

These important survey findings can be further contextualised through qualitative engagement with scientists living through the pandemic. The widely constructed novelty and singularity of the biosocial ramifications of SARS-CoV-2 have produced a set of epistemic and social circumstances that are experienced by many as unique. Exploring how scientists construct and navigate the resulting disruptions to their work is illustrative of the social and scientific norms of research—and their experiential and epistemic impacts. Through interviews with early-career scientists, and additionally informed by the authors’ position within a research-intensive Medical School, this paper offers a modest contribution to this mission to better understand the effects of the pandemic on biomedical scientists. In doing so, it aims to provide indicative avenues for more sustained exploration by other scholars of science and society.

Producing scientific knowledge. Sociological research has long challenged the objectivist ideal underpinning positivist views of science (Fujimura and Chou, 1994). It has, for instance, illustrated the distinct epistemic cultures (Knorr-Cetina, 1999) that exist within science—with unique and often incommensurable standards for justification and evidence. Such factors play a role in influencing which projects scientists pursue, the design of their research, and the assumptions they incorporate into their work. Researchers’ social interests and location can further act as epistemic catalysts, with matters such as political ideology, moral beliefs, and organisational settings framing the pursuit of particular research questions (Barnes, 1977; Fujimura and Rajagopalan, 2011; Longino, 1990; Vertesi, 2020). More generally, scientists are, of course, social actors who also inhabit a world beyond the laboratory which gives meaning to their activities (Barnes and Shapin, 1979), and who experience emotions that shape what they research and how (Pickersgill, 2012). Professional and personal interests and values consequently have constitutive roles within processes of knowledge production.

It is these and related empirical and theoretically orientated literatures from science and technology studies which provide the conceptual backdrop for this paper. Specifically, the article is undergirded by the contention that scientific knowledge production is a social process, and its nature and trajectory are constituted through a range of material and semiotic factors (Barnes, 1982; Fujimura, 1988; Knorr-Cetina, 1981; Latour and Woolgar, 1979; Lynch, 1993; Woolgar, 1988). Ultimately, the knowledge scientists produce is shaped by their epistemic, economic, political, and personal contexts, interests, and goals.

In this spirit, Felt (2009) has introduced the concept of ‘epistemic living spaces’, referring to the “symbolic, social, intellectual, temporal and material” structures that “mould, guide and delimit, in more or less subtle ways, researchers’ (inter)actions, what they aim to know, the degrees of agency they have and how they can produce knowledge” (Felt, 2009, p. 19; Felt and Fochler, 2010). These living spaces can be regarded as also constituted through, and enabling, particular ‘regimes of normativity’ (Pickersgill, 2012; Martin and Turkmenag, 2021): wider norms and values that inform what is considered to be good, proper, and ethical action—and hence good, proper, and ethical science. If scientific work is undertaken within particular epistemic living spaces, then these are not necessarily comfortable; they are themselves sites within which both scientists and the knowledge they produce are disciplined.

Scientific work in context. Within the lab—the literal epistemic living space of many scientists—researchers strive not only to pursue good science (Thompson, 2013), but also creditable science. Latour and Woolgar (1979), for instance, have underscored scientists’ goals of accruing highly cited publications (for a more recent discussion of these issues, see Pinel, 2022). Such articles can be leveraged for greater opportunities and resources, and remain a vital component of career-building. However, Knorr-Cetina (1981) has also warned against reducing scientists to *Homines economici*, motivated only by the pursuit of credibility and capital. Rather, scientists’ work is shaped by a whole range of social and contextual factors, including their familiarity with specific methods (Knorr-Cetina, 1981). Moreover, science needs to be ‘doable’ (Fujimura, 1987): for work to progress and for any outcomes to be achieved at all, alignment is needed between what is desirable and what is possible. Publications are important in science, to be sure—but they are not everything.

Still, the (potential) accumulation of creditable outputs nevertheless shapes scientific knowledge production in important ways. So, too, does the availability and nature of funding. Policymakers

use funding as a tool, incorporating public policy goals into the aims of funding programmes (Ravetz, 1971). In the context of scarce funding (Guston, 2000), scientists commonly construct their research questions to align with the agendas of funding bodies (Gläser and Velarde, 2018). The increasing ties between universities and commercial industry similarly influence knowledge production (D'este and Perkmann, 2011; Fochler, 2016), realigning the values, logics, and goals of science (Berman, 2014; Hoffman, 2011). Funding is also a key means of securing institutional and disciplinary prestige. For senior scientists, career- and reputation-building can, though, be imbricated with the more altruistic aim of protecting the jobs of especially early-career researchers. Over the course of their careers, many scientists build teams—and ongoing grant money is needed to keep team members in employment. The availability and nature of funding consequently shape the practices of scientific work and the epistemic products that workers labour towards in significant ways, with scientists often adopting a 'portfolio' approach to their work that enables different kinds of funding to be sought (Rushforth et al., 2019).

Today, time pressures (Müller, 2014a) and the need to maintain a high research output impact research activities in an increasingly 'entrepreneurial' university sector (Etzkowitz, 2013; Kleinman et al., 2018; Tuunainen and Knuutila, 2009). One result of this is that some scientists select against time-consuming methodologies with uncertain chances of success (Müller, 2014a). Evaluative frameworks are another pressure, with academic audits and other assessment metrics driving scientists to construct their research in a manner that meets institutional criteria for acceptable levels of productivity and impact (de Rijcke et al., 2016; Pinel, 2020; Wróblewska, 2021). Competition for employment likewise drives early-career scientists to assign value to potential research projects in terms of their potential to act as valuable career assets, such as the generation of publications (Fochler, 2016). While other scholarly interests and concerns can be accommodated, this is through subordinating these to a 'logic of production' (Müller, 2014b). Such a focus on productivity, however, risks narrowing the range of epistemic projects that scientists might pursue, with implications for the generation of new knowledge (Fochler et al., 2016; Pinel, 2022; Whitley et al., 2018)—and potentially compromising research culture and conduct (Anderson et al., 2007).

In what follows, we will see how some of these issues shape early-career scientists' accounts of their work within a 'lockdown'. In doing so, we draw on Felt's concept of 'epistemic living spaces' to help ground and shape our analysis (Felt, 2009; Felt and Fochler, 2010). The paper casts light on the discursive and, indeed, material reshaping of these during the COVID-19 pandemic, and explores how accounts of publications, funding, and other pressures are constructed and negotiated within our respondents' talk.

Methodology

The paper draws on a convenience sample of eight semi-structured interviews with postdoctoral biomedical scientists working at one UK university. Postdoctoral scientists comprise a critical component of universities' research infrastructures (Park, 2020), and survey evidence has indicated that this group of knowledge workers has been significantly impacted by the pandemic (Woolston, 2020). The interviews sought to understand what challenges early-career researchers had faced over the course of the pandemic to-date, and why they might (not) allocate their time and expertise towards studying COVID-19.

For practical reasons, the period of data-collection was limited to March 2021—during one of the UK 'lockdowns'. At this point in the pandemic, the respondents had experienced about a year of disrupted work and such disruptions were part of mainstream

conversations within scientific journals and universities. Research into COVID-19 was also happening at scale, and some UK-based scientists had already begun to garner tangible professional credits for their work in this area (honours, prizes, and so on). Our respondents were consequently at a point where they could reflect on the changes they had seen, the experiences they had lived through, and the science that had emerged.

Undertaking interviews during lockdown naturally came with several challenges. For a start, data collection was undertaken entirely online (via Microsoft Teams). While there are some implications for rapport in relation to online interviews, by spring 2021 scientists were highly familiar with Teams/Zoom-based discussions. The most significant issue we encountered was in relation to recruitment. Despite strong support from the large number of people we contacted as gatekeepers, we struggled to recruit respondents during the requisite timeframe. Although others have successfully conducted interviews with busy workers during the pandemic (e.g., Montgomery et al., 2021), we suggest that this could reflect the particular difficulties postdoctoral scientists face and the pressures they felt (discussed below).

Our respondents specialised in a range of fields, including cancer research, epidemiology, and infectious diseases. All interviews took place following informed consent, and were recorded and auto-transcribed through Teams (and subsequently checked against the recording for accuracy and edited as appropriate). Thematic analysis of the transcripts was undertaken thereafter, with an open coding approach facilitated with NVivo. The analysis attended especially to what and how disruptions to laboratory work and adaptations were accounted for, how the advantages and disadvantages of studying COVID-19 were framed, and how agency in scientific work was implied and negotiated. We were sensitive to if and how the respondents' accounts indicated that the epistemic living spaces of science were being reworked through the pandemic, and the implications of this for producing knowledge (including that relevant to addressing the challenges of COVID-19 itself).

The analysis was, and this paper is, additionally contextualised through the second author's position as a sociologist of science and medicine with leadership responsibilities in a Medical School. Consequently, over the course of the pandemic he had very many interactions with scientists across the professional life course. These inevitably shaped the analysis, and the selection of what data to present in this article and how to do so. Given our own difficulties in undertaking sociological research at pace and in circumstances that we ourselves also experienced as professionally and personally challenging, this paper was itself synthesised through some of the same kinds of dynamics that we report on below.

In the following two substantive results sections we discuss, first, what kinds of disruptions to their work the scientists we interviewed accounted for as important over the course of the pandemic, and second, why—given these challenges—early-career scientists might (not) research COVID-19. In our discussion, we further reflect on the provisional findings described and their interconnections. We go on to suggest varieties of sociological scholarship that might be advanced in light of them.

Dealing with disruptions

The pandemic has produced major disruptions for the practical arrangements of scientific knowledge production with its associated lab closures and social distancing requirements. These are lamented by scientists across the professional life-course. Much work ground to a halt, with significant uncertainty about how long a 'COVID pause' might last. Overwhelmed funding agency staff sometimes struggled to provide answers to questions about grant extensions with the immediacy that was often required. Some offers of funding

(and hence possibilities of employment for early-career scientists) were even revoked by newly cash-strapped charities. Several UK universities managed budgetary crises through freezes to hiring and promotion processes. Often, then, early-career scientists were navigating not just uncertainty about how to produce knowledge, but also their employment status and the many ramifications of that. The foundations of their epistemic living spaces (Felt, 2009, p. 19; Felt and Fochler, 2010) became increasingly shaky.

When it became clear that social distancing was going to be far from short-term, institutions incurred major procedural headaches when seeking to ensure that laboratory-based research could still happen, even during lockdowns. Estates staff and administrators, along with scientists, worked hard to implement policies and processes such as one-way access, site check-ins via QR codes, regular lateral flow tests for SARS-CoV-2, and so on. Beyond the practical questions of how to manage the physicality of science when embodied interactions were a key source of risk, the affective dimensions of this also had to be managed. The governance of subjectivities and relationalities consequently interacted with the procedural challenges of (not) accessing labs, remaking the sociality and materiality of epistemic living spaces. Ultimately, laboratory-based knowledge-production was enabled during the COVID-19 pandemic—but not for everyone, not in the same way, and not all the time.

(No) Time in the Lab. Those of our respondents who primarily worked within labs all described significant difficulties conducting practical work during the pandemic. As Participant 5 reported: “I guess it was just like completely put on halt as soon as lockdown started because I couldn’t do any of the lab work and I didn’t really have my own data to analyse”. Whilst all participants were able to return to their labs after the easing of the first lockdown, on-going challenges were nevertheless present. This included the possibility of further public health restrictions:

When lockdown was lifted it was then quite slow to get up and going again... you didn’t want to kind of get everything up and going again in case there was another lockdown (Participant 5).

While researchers are familiar with the demanding temporalities of science and orientating their work to those (Müller, 2014a, 2014b), the uncertainties and irregularities that changing restrictions imposed also shaped knowledge production.

Shift work, governed through new booking systems for lab spaces, became common as a means of complying with social distancing restrictions in conditions of finite laboratory space and a need to limit the number of individuals in a building at any one time. Consequent challenges included the misalignment of restrictions with the temporal requirements of experiments, with participants finding it difficult to get into the labs often enough to complete their experiments. Participant 1, for instance, was undertaking work that required them “to be in the Institute every 12 h”. However, because of shift work, this was not possible: “So, by definition, you are unable to do my work because you can’t be there within a 12-hour period”. Time, then, was accounted for as a clear material constraint for scientific work which had rhythms that did not necessarily align with the timings that public health restrictions imposed.

As Participant 3 described, such shift work resulted in the pace of research becoming “a lot slower”—a key concern for early-career researchers accustomed to particular intersections between challenging yet normalised temporal and epistemic regimes (Müller, 2014a, 2014b). This had impacts on the outputs of research—on the production of data and the articles through which it was disseminated:

I feel that my research output has been massively affected. I do feel that it has been extremely challenging to actually do research and I imagine research output will be quite severely affected by the pandemic (Participant 6).

The constraints of space and pace were especially acute for scientists with caring responsibilities. For Participant 6, a mother, shift work added an “extra layer of challenge” to the planning of experimental research:

I’m already fairly restricted in terms of how I can get into work. For example, I work part time ‘cause I have children, so I kind of haven’t necessarily got all day that I can access the lab. So if I then find that the lab is booked up from nine till three, it’s a bit difficult for me.

If temporality is a feature of epistemic living spaces that shape what research can be conducted (Felt, 2009, p. 19; Felt and Fochler, 2010), ‘pandemic time’ means existing inequalities can be extended not just in relation to the quantity of time available but when time itself makes science ‘doable’ (Fujimura, 1987).

Exploring desk-based activities. Scientists orientate to the sociability of their epistemic living spaces in different ways, which also vary in relation to what needs to be achieved in any given day. As Participant 6 reflected, “I find the lab quite a busy place”; as such, “I don’t do a lot of like concentrated work at the lab. I’d rather do that at home, things like reading and sort of thinking about things and planning.” During the lockdowns, such ‘desk-based activities’ moved to the fore. Whilst the challenges of lockdown home-working are well-known (Crook, 2020), some of our interviewees constructed benefits from this new situation:

I think this has made me aware that I think there might be some activities which I really appreciate doing from home, like writing. Sometimes writing a paper then I just don’t want to have any disruptions (Participant 4).

Several scientists we interviewed or spoke with worked on systematic and other kinds of review papers relating to their research. Participant 6 described the benefits of this as follows:

I’m relatively new to the project that I’m working on so... it was quite nice for me to be able to get a bit more out of the literature than I had done previously, like from starting the project.

This participant found producing their review paper to be useful for their practical work too, shaping the direction of not only their current studies but also potentially their future research:

It gave me ideas for my work and it’s definitely probably changed... the focus of what I would look at... It’s certainly given me more understanding of the area that I’m working in and where I can fit into it. And so even thinking ahead for future funding applications like I can, I feel, more easily see where there would be gaps and where I could think of ideas.

By explicitly embroiling non-laboratory-based epistemic practices within their accounts of pandemic work, such comments underscore how science is a multimodal activity far beyond solely experimental praxis. At the same time, articulations of this multimodality can itself be considered as part of the accounting practices of researchers keen to justify their work as ‘still science’ at a time when many early-career scientists expressed anxiety about productivity and data generation. Some respondents, for instance, described taking time to explore desk-based research methodologies, particularly computational bioinformatics

methods; these were presented as ideal replacement for lab work in the context of work-from-home regulations.

Still, despite often achieving success pursuing alternative research tasks, most participants were keen to return to their labs as soon as possible, indicating that such practical and rhetorical adaptive shifts may have a temporary nature: “So I think I’ve kind of improved some bioinformatics skills, but I know it’s not really kind of contributed to my primary research” (Participant 5).

Adapting to online communication. The pandemic resulted in a major shift to online methods of communication, and our participants reported various challenges for local collaboration associated with these. Several argued that diminished frequency of communication had a negative impact on their research. Participant 3 felt that having to schedule lab meetings to share ideas introduced a rigid, non-negotiable structure to innovation, ultimately making it harder to share ideas:

We can still meet regularly on Zoom, so we still throw ideas around all the time. It does stifle innovation to be so regimented with meetings, so if you have to set a meeting to share ideas that’s quite a barrier.

Participant 4 expressed a similar sentiment, describing how “I think that sometimes it’s really that you get inspired by your peers by just having discussions on the lower level... that social interaction also results in better research”. Hence, an absence (or at least, recasting) of sociality may have detrimental implications for scientific knowledge production.

Such issues were compounded for researchers like Participant 6 with caring responsibilities:

But then there’s also times where people meet for coffee breaks... because I’m working at home and taking the flexibility of working at home and juggling children it means that quite often I won’t attend those coffee breaks because it’s just not a time that suits me.

Again, then, ‘pandemic time’ has uneven effects on different members of communal epistemic living spaces.

Whilst local collaboration may have been hindered, our interviewees and others we spoke with more informally described some benefits for international collaboration. As Participant 4 reflected, “I think maybe before the pandemic sometimes people find it more hassle to setup a digital meeting.” However, now that such meetings were routine, engagement with distant colleagues was normalised: “now everybody says ‘oh yeah, it’s just how it is’. And it makes it somehow easier”. In this respect, some temporalities occasioned by the pandemic—specifically, the routinisation of setting up online discussions—were framed as affording epistemic benefits.

Relatedly, others highlighted the benefits of online conferences, emphasising the increased convenience arising from being able to access video presentations at any time and the accessibility due to reduced cost:

Last year I attended maybe at least four or five conferences. Usually that is very hard for me to attend. Those are very top conferences, I really want to go. The price of the conference was cheaper simply because it was held virtually (Participant 8).

However, this sentiment was not expressed by all participants, with some stating that online conferences lacked the engagement and social appeal of regular, in-person conferences. This seemed to reflect a wider ennui: as Participant 4 put it, with long-term homeworking “you start missing your colleagues and the social stuff of course, because at the end of the day I’m also a human

being”. Again, the constitutive importance of the sociality of epistemic living spaces (Felt, 2009, p. 19; Felt and Fochler, 2010)—and, indeed, of living *per se*—was cast in sharp relief.

Anxieties. Unsurprisingly, our participants also reported various anxieties and pressures during the pandemic—including familiar challenges of work/life balance when working from home. Curtailments on the opportunity to generate primary data was a critical concern for many:

I think at the beginning of the year I felt a bit worried that maybe I wasn’t going to be able to go at all to the labs. So I was like, well what am I going to do? I don’t have like a lot of data to analyse (Participant 2).

I think it’s more just that in terms of career progression, I guess at the end of the day we get judged more on our research output, like our lab-based output, than we do on anything else. So I guess there’s a need for me to generate that kind of data (Participant 6).

These worries were often articulated with reference to publication-based evaluative metrics, aligning with other studies of their impacts on postdoctoral scientists (de Rijcke et al., 2016) (and on science more generally; Pinel, 2022):

There’s always the worry of kind of losing your job, right? So I think that’s the biggest pressure, that you need to do—there’s always this kind of mantra of publish or perish. So you always feel like you need to somehow get results despite having not having been in the lab for ages, and to publish to then also be able to kind of maintain your career (Participant 5).

Early career-scientists are accustomed to striving hard to achieve the kinds of results and targets promised by senior investigators within their grant applications. Consequently, the need to fulfil the requirements of research funding represented a further concern for some researchers:

I mean I guess this bit of like extra pressure, you know, feel like we need to get something to kind of show for what we’re doing and our funding runs out in I think like September this year so, you know, come summertime we need something, some data to show (Participant 5).

These specific worries sat alongside more long-term concerns (which were also widely felt beyond the interview sample), grounded in the knowledge that the pandemic had disrupted the usual sources of funding too:

In terms of funding in the future, I’m a little bit worried... For example, the British Heart Foundation’s collected much less money than they normally would have done. Yeah and it might also impact further projects that maybe would have been funded, which now is maybe going to happen that it’s not going to be funded (Participant 4).

A frequently expressed concern within and beyond biomedicine, and often raised by our respondents, was the mental health impacts of the pandemic. As Participant 5 argued, COVID-19 had exacerbated what was already a major issue for early career researchers: “It’s just made things a lot lot worse”.

In sum, the disruptions that the scientists we interviewed accounted for as significant during the COVID-19 pandemic were numerous, and shaped by the social, spatial, and temporal dimensions of scientific work—underscoring how these are vital in the production of living spaces that are not just liveable, but also, for some, comfortable. Against this backdrop, we turn now

to consider the accounts our respondents advanced in relation to why researchers might (not) reorientate their activities to producing knowledge relating to the pandemic.

On (not) 'pivoting' towards COVID-19

While the term 'COVIDization' underscores the turn towards the pandemic on the part of many researchers, a complete shift to COVID-19 has not been a uniform feature of biomedical science. Rather than simply dropping pre-existing work and attending fully to COVID-19 to the restriction of all else, many scientists partially shifted their focus, as part of a portfolio approach (Rushforth et al., 2019) to managing research—and many others did not shift at all. Within our interview sample, six of eight participants reported having considered moving into COVID-19 research at some stage, with only Participant 8 actively undertaking some work in this area. In what follows, we set out how our interviewees accounted for the appeal of COVID-19 research, as well as why many do not 'pivot' towards it.

The appeal of COVID-19 research. The significance of the pandemic was framed as a key reason why research into COVID-19 might be considered. This was constructed through personal and wider societal saliences which characterised scientists' epistemic living spaces (Felt, 2009). On a personal level, the extensive impacts of COVID-19 on participants' social worlds were often invoked to explain an academic interest in the topic:

I think maybe in a lot of situations you are dependent on the whole pandemic and maybe your work is affected, and I can imagine that you also try to look at the opportunities to be involved in COVID-19 research (Participant 4).

Participants leveraged the widespread biosocial problems the pandemic created as an urgent rationale for the mobilisation of biomedicine (see relatedly Gibney, 2020). In Participant 8's words, "Everyone was affected by COVID directly or indirectly"—there was "no point not to be doing COVID-19 research". This is also a frequent refrain within wider biomedical discourse. Such accounts underscore scientists' reflexivity in relation to their awareness of how social and material worlds shape their epistemic living spaces. At the same time, they also reinforce the centrality of already socially significant discourse (i.e., 'COVID is important'), potentially eliding other factors that contour what knowledge is (not) produced, how, and why.

The availability of funding was emphasised as a key factor in considerations of whether to reorientate research. Various funding schemes have emerged to support activity around COVID-19, and these were noted by our postdoctoral interviewees as contributing to the draw of research in this area. Such funding represented an opportunity to access scarce resources and to potentially generate highly-cited publications – as a "hot topic", work on COVID-19 was argued to have the potential to "attract some attention" (Participant 8). In Participant 1's words: "wherever there is funding, those folks will come". Over 2020 especially, many biomedical researchers were considering how they could 'pivot' their research towards COVID. As Participant 5 put it: "I think right at the start there was a bunch of like extra funding, so I guess there was maybe like a thought that we could maybe use organoids for it". In this respect, changes to epistemic living spaces can be read as informing how scientists might reposition the work that they are currently undertaking within these, rather than starting from scratch.

As a range of scholars have shown, career pressures and (a lack of) funding opportunities contour the intellectual and practical agendas of early-career scientists (Gusto, 2000; Gläser and Velarde, 2018; Müller, 2014a, 2014b). The accounts of our interviewees, and the visible actions of biomedical scientist more

widely, illustrate how different kinds of interests are entangled within scientific endeavours. Accordingly, an expressed interest in helping to tackle a global pandemic is not incommensurable with an interest in, for instance, developing one's career at a time of increasing precarity and heightened uncertainty. Rather, this situation illuminates how knowledge in science is reciprocally constituted through different elements (Barnes, 1982; Fujimura, 1988; Knorr-Cetina, 1981; Latour and Woolgar, 1979; Lynch, 1993; Woolgar, 1988)— rendering problematic attempts to reduce biomedical intent to, for instance, straightforwardly careerist or altruistic goals.

Avoiding COVID-19 research. Although all participants accounted for the importance of COVID-19, as noted above only one of our interviewees shifted their scientific focus to the pandemic; indeed, Participant 3 "didn't want to touch it" despite their cognate existing research. When recounting their rationale for not 'pivoting' away from their ongoing studies, some participants emphasised their commitment to their pre-pandemic research focus (which could itself have been shaped through interactions with senior scientists, including line-managers). Participant 4 described this as follows:

When the pandemic started I thought this is the ideal moment to focus on my projects because I'm not disturbed by anything else. So I avoided all the COVID-related topics, and I think that was for myself personally a good decision not to be distracted by COVID-related research.

They further reflected: "I think there are much more clever people than me that should pay attention to it and can help to inform current clinical practice better than I do".

For others, a perceived lack of coordination in the overall approach to COVID-19 research was also described by one participant, which they asserted risked repetitive research being carried out:

Everyone's trying to do COVID and mental illness now. And there's still value in doing the other stuff, so not kind of end up doing something that someone is already doing. I think there was a lack of joined up- there wasn't like one person leading, so there was kind of a risk of different research groups trying to do the same thing (Participant 7).

As Participant 7's comments also illuminate, widely replicating a research effort is not simply a poor public health strategy, but one that would also pay reduced professional dividends for individual researchers. This is a particularly important consideration for early-career scientists on 'soft money' (i.e., whose positions are funded from external grants) who need to distinguish their epistemic contributions within a crowded marketplace to secure future employment.

Participant 1's various accounts of why they maintained their pre-existing research focus are illustrative of the different rationales that shape scientific work. Reflecting wider concerns sometimes informally advanced within biomedicine, Participant 1 suggested that the neglect of other areas would lead to the worsening of non-COVID problems:

I think it's just very fashionable now, those infectious diseases. But, like, if you focus like that it's not good... We have other problems. We have all sorts of problems. That's the whole point of science... It's not good to overspecialise and be super narrow. But like... if you just go swing yourself towards one task, everything else will be horrible.

Research is synthesised through interacting affects, normativities, and epistemic concerns (Felt, 2009; Pickersgill, 2012;

Thompson, 2013), and Participant 1's comments perhaps speak to how a sense of social and professional obligation shapes, to some extent, scientists' research activities (much like those which, in contrast, emphasise the appeal of research on COVID-19). As Participant 1 also described: "I got basically employed for a particular task and I didn't want to, uh, divert away from it too much". This is a key issue: the work of early-career scientists is shaped in important ways by employment relations as well as wider epistemic and economic contexts. Put plainly: it is very difficult for a researcher to reposition their activities in order to generate knowledge about covid if their line-manager says 'no'.

Unsurprisingly, though, career strategy also played a role in Participant 1's account. Like other scientists we interviewed or spoke with, they constructed the field of COVID-19 as increasingly crowded, with swathes of researchers competing for funding and attention (from journals, policymakers, and the media). For Participant 1, though, while new pandemic funding schemes might be desirable to access, working in a crowded field was presented as disincentivising an oft-valorised 'pivot' to researching COVID-19:

I didn't want to do any COVID research because I knew the competition is insane... you are competing with all those vaccine producers and everyone there and the whole United States and everyone is focused there... I'm a small player... It's just a question of strategy (Participant 1).

We can read these reflections in at least two, not necessarily conflicting ways. First, they suggest that different types of rationale can interact to substantiate why a change of activity to undertake research in COVID-19 is *not* undertaken, just as they can entwine to provide justify a move in this direction. Second, Participant 1's words underscore the centrality of 'career strategy' as a norm against which scientific decisions are justified (Anderson et al., 2007) and even *should* be justified (in the eyes of the players of the career 'game'). In this respect, it can be taken to be part of the regime of normativity (Pickersgill, 2012) operant within the contemporary 'entrepreneurial' university (Etzkowitz, 2013; Kleinman et al., 2018; Tuunainen and Knuutila, 2009).

Alongside all of this sit structural and practical constraints and concerns that limit and contour the facility of scientists to autonomously and reflexively 'decide' what to research at all. In particular, several participants expressed concern about "starting from scratch" once again in their research if they sought to study COVID-19. This would take time that they simply did not have to spare:

Unfortunately, because of the nature of my work, it's a bit of a different branch, so I think I would have to learn stuff from scratch (Participant 2).

I just felt that it would be starting from scratch again, whereas I had just started from scratch in this project, so I kind of felt it would be better for me just to carry on with what I was doing (Participant 6).

These concerns underscore the strategic judgements scientists make (Whitley et al., 2018) or are encouraged towards when ascertaining how to allocate their time—which is experienced as a finite resource—in order to maintain an efficient research output (Müller, 2014a, 2014b).

Discussion and recommendations

The COVID-19 pandemic has been experienced as hugely challenging time for many, including scientists. This exploratory paper has provided analytic reflections on how some of those challenges were constructed and negotiated by UK-based post-doctoral biomedical scientists working within one research-

intensive university. Our claims-making is limited by a modest sample size, with a further limitation being the lack of a longitudinal study design which would have usefully illustrated how changing public health policy and the scientists' lived experiences interacted and shifted over time. Nevertheless, the data presented provide an important window into scientific life under lockdown, alongside indicative avenues for further, more in-depth sociological examination. This section will explore some of the central issues emerging from our data, and highlight how these might be explicated in greater detail by other scholars.

The sociality, spatiality, and temporality of knowledge production were changed through lab closures and social distancing requirements: we saw these shifts ourselves through the experiences of friends and colleagues, and they were visible within the accounts of our respondents. Research was situated within the context of the home, or through reconfigurations of lab work in relation to who could access university settings, for how long, and for what—remaking, sometimes literally, scientists' epistemic living spaces (Felt, 2009, p. 19; Felt and Fochler, 2010). This recast what kinds of epistemic products scientists could labour towards. Our interviewees, as well as other scientists we spoke with, adapted to their changing circumstances through, for instance, the exploration of alternative, desk-based activities. Further, scientists also moved extensively towards online communication, reorganising the collaborative processes that underpin the production of knowledge. Our respondents suggested that this might facilitate international collaborations while hindering more local interactions—and hence stymying the epistemic catalysis these could stimulate.

Further multidisciplinary, comparative research is warranted that closely examines across different specialisms, career stages, and countries how the shifting spatial configurations of biomedical investigations during the COVID-19 have impacted on how knowledge is produced, and how this relates to and is also constituted through scientists' relations with it and one another.

Drawing again on both our data and wider experiences of conducting sociological scholarship within biomedical worlds, we have found that researchers working in biomedicine and public health were encouraged, not least through funding and symbolic incentives, to 'pivot' their work towards the study of SARS-CoV-2 and its biosocial ramifications. During interviews, early-career scientists' accounts of their involvement—or, more usually, lack of involvement—in COVID-19 research were structured by personal values and social interests, with epistemic activity constrained and contoured in important ways by practical exigencies and professional norms. For some, the impact of the pandemic on both personal and professional aspects of life appeared to urge an academic interest in COVID-19. For others, the pressing nature of the issues created by the pandemic was articulated through a desire to be involved in research aimed at addressing critical social problems, with many expressing a belief that this was what the purpose of knowledge production ought to be. These factors generated both an epistemic and a normative appeal to researching COVID-19. Participants' accounts in this regard were grounded in their awareness of the wider context of 'COVID-ization' within biomedicine (Pai, 2020)—the shift of scientists, funding bodies and journals to COVID-19 (Giustini et al., 2021). Some presented the value of research into the pandemic in terms of the potential it represents to secure further or future funding, and to generate highly cited (and societally impactful) publishable results. These are issues of import to scientists (Pinel, 2022), not least in the context of scarce funding (Guston, 2000) and academic audits (Müller, 2014a, 2014b), and in relation to generating future employability (Fochler, 2016).

There is a need to extend existing work considering what counts as incentives in science, how these function within particular epistemic contexts, and how they differ across the professional life-course. The plethora of funding schemes for COVID-19, and their relatively distinct application processes and temporalities, collectively provides an important case study for such sociological and historical research.

We also found that while scientist might account for the pursuit of research into COVID-19 as an attractive prospect, they did not always recalibrate their work to the production of knowledge in this area. Within our interview sample, only one scientist 'pivoted' to the pandemic. Among the accounts of those not undertaking a socially and professionally valorised shift to researching COVID-19, participants' existing epistemic and normative ties to other areas of research were, for instance, accounted for as a counterforce to the pull of the pandemic. This speaks to wider norms within science about the pursuit of specialisation and the need to demonstrate a clear intellectual trajectory in order to progress in biomedical careers. Further, our respondents discussed their own facility to 'make a difference', and to sufficiently 'stand out', reflecting on the challenges in relation to this for their work. Such accounts of inaction underscore the centrality of 'strategy' in relation to careers (Anderson et al., 2007; Müller, 2014a, 2014b) as part of the regimes of normativity (Pickersgill, 2012; Martin and Turkmenag, 2021) structuring the entrepreneurial university (Etzkowitz, 2013; Kleinman et al., 2018; Tuunainen and Knuutila, 2009) and scientists' epistemic living spaces within this (Felt, 2009, p. 19; Felt and Fochler, 2010).

Future anthropological and sociological scholarship could more closely consider: (a) how conditions experienced as a crisis—including but not limited to the pandemic—interrelate with longstanding professional conditions and dynamics (such as a need to act 'strategically') that can place limits on how such crises are collectively tackled, and (b) how epistemic and practical responses to crises can themselves cast new light onto the social and economic dimensions of science.

Conclusion

Though this exploratory paper we have indicated how the experiential and rhetorical conditions stimulated by the pandemic can interact with pre-existing professional discourses and practices within biomedical science—e.g., in relation to funding and career capital—to inform and delimit knowledge-production. This includes the potential to produce knowledge (or not) about the pandemic itself. Though our analytic reflections, we have suggested some of ways through which future sociological research might build on our provisional findings in order to cast new light on the effects of the pandemic on biomedicine, as well as on the entangled social, economic, and epistemic dynamics of science more generally.

Data availability

Ethical approvals were not in place to allow data sharing and reuse.

Received: 17 December 2021; Accepted: 31 March 2022;

Published online: 21 April 2022

References

Anderson MS, Ronning EA, De Vries R, Martinson BC (2007) The perverse effects of competition on scientists' work and relationships. *Sci Eng Ethics* 13:437–461

Barnes B (1977) Interests and the growth of knowledge. Routledge, London

Barnes B (1982) T. S. Kuhn and social science. Macmillan Publishers Ltd, London

Barnes B, Shapin S (1979) Natural order: historical studies of scientific culture. Sage Publications, Beverly Hills, CA

Berman EP (2014) Not just neoliberalism: economization in US science and technology policy. *Sci Technol Hum Values* 39(3):397–431

de Rijcke S, Wouters PF, Rushforth AD, Franssen TP, Hammarskjöld B (2016) Evaluation practices and effects of indicator use—a literature review. *Res Eval* 25(2):161–169

Crook S (2020) Parenting during the Covid-19 pandemic of 2020: academia, labour and care work. *Women's Hist Rev* 29(7):1226–1238

D'Este P, Perkmann M (2011) Why do academics engage with industry? The entrepreneurial university and individual motivations. *J Technol Transf* 36(3):316–339

Etzkowitz H (2013) Anatomy of the entrepreneurial university. *Soc Sci Inf* 52(3):486–511

Felt U (ed.) (2009) Knowing and living in academic research: convergence and heterogeneity in research cultures in the European context. Institute of Sociology, Academy of Sciences of the Czech Republic, Prague

Felt U, Fochler M (2010) Re-ordering epistemic living spaces: on the tacit governance effects of the public communication of science. In: Rödder S, Franzen M, Weingart P (eds.) *The sciences' media connection—public communication and its repurcussions*. Springer, pp. 133–154

Fochler M (2016) Variants of epistemic capitalism: knowledge production and the accumulation of worth in commercial biotechnology and the academic life sciences. *Sci Technol Hum Values* 41(5):922–948

Fochler M, Felt U, Müller R (2016) Unsustainable growth, hyper-competition, and worth in life science research: narrowing evaluative repertoires in doctoral and postdoctoral scientists' work and lives. *Minerva* 54:175–200

Fujimura JH (1987) Constructing 'do-able' problems in cancer research: articulating alignment. *Soc Stud Sci* 17(2):257–293

Fujimura J (1988) The molecular biological bandwagon in cancer research: where social worlds meet. *Soc Probl* 35(3):261–283

Fujimura JH, Chou DY (1994) Dissent in science: styles of scientific practice and the controversy over the cause of AIDS. *Soc Sci Med* 38(8):1017–1036

Fujimura JH, Rajagopalan R (2011) Different differences: the use of 'genetic ancestry' versus race in biomedical human genetic research. *Soc Stud Sci* 41(1):5–30

Gibney E (2020) The pandemic mixed up what scientists study—and some won't go back. *Nature* 582(7811):173–174

Giustini A, Schroeder A, Axelrod D (2021) Trends in views of articles published in 3 leading medical journals during the COVID-19 pandemic. *JAMA Netw Open* 4(4):e216459

Gläser J, Velarde KS (2018) Changing funding arrangements and the production of scientific knowledge: introduction to the special issue. *Minerva* 56(1):1–10

Guston DH (2000) Between politics and science: assuring the integrity and productivity of research. Cambridge University Press, Cambridge

Hoffman SG (2011) The new tools of the science trade: contested knowledge production and the conceptual vocabularies of academic capitalism. *Soc Anthropol* 19(4):439–462

Johnson TP, Feeney MK, Jung H, Frandell A, Calderaro M, Michalekko L, Islam S, Welch EW (2021) COVID-19 and the academy: opinions and experiences of university-based scientists in the U.S. *Humanit Soc Sci Commun* 8:146. <https://doi.org/10.1057/s41599-021-00823-9>

Kleinman DL, Feinstein NW, Downey G, Peterson S, Fukada C (2018) Hybrid experiments in higher education: general trends and local factors at the academic-business boundary. *Sci Technol Hum Values* 43(3):540–569

Knorr-Cetina KD (1981) The manufacture of knowledge: an essay on the constructivist and contextual nature of science. Permagon Press, Oxford

Knorr-Cetina KD (1999) Epistemic cultures: how the sciences make knowledge. Harvard University Press, Cambridge, MA

Latour B, Woolgar S (1979) Laboratory life: the social construction of scientific facts. Sage Publications, Beverly Hills, CA

Longino H (1990) Science as social knowledge. Princeton University Press, Princeton, NJ

Lynch M (1993) Scientific practice and ordinary action. Cambridge University Press, Cambridge

Madhusudanan J (2020) Frozen cells and empty cages: researchers struggle to revive stalled experiments after the lockdown. *Nature* <https://doi.org/10.1038/d41586-020-01704-y>

Martin PA, Turkmenag I (2021) Thinking the unthinkable: how did human germline genome editing become ethically acceptable? *New Genet Soc* 4(4):384–405

Montgomery CM, Humphreys S, McCulloch C, Docherty AB, Sturley S, Pattison N (2021) Critical care work during COVID-19: a qualitative study of staff experiences in the UK. *BMJ Open* 11:e048124. <https://doi.org/10.1136/bmjopen-2020-048124>

Müller R (2014a) Racing for what? Anticipation and acceleration in the work and career practices of academic life science postdocs. *Forum Qual Sozialforsch* 15(3): <https://doi.org/10.17169/fqs-15.3.2245>

Müller R (2014b) Postdoctoral life scientists and supervision work in the contemporary university: a case study of changes in the cultural norms of science. *Minerva* 52:329–349

Pai M (2020) Covidization of research: what are the risks? *Nat Med* 26:1159. <https://doi.org/10.1038/s41591-020-1015-0>

Park DS (2020) The invisible university is COVID-19 positive. *Trends Genet* 36(8):543–544

Pickersgill M (2012) The co-production of science, ethics, and emotion. *Sci Technol Hum Values* 37(6):579–603

Pinel C (2020) Renting valuable assets: knowledge and value production in academic science. *Sci Technol Hum Values* 46(2):275–297

Pinel C (2022) What counts as the environment in epigenetics? Knowledge and ignorance in the entrepreneurial university. *Sci Culture*, <https://doi.org/10.1080/09505431.2022.2043840>

Ravetz JR (1971) Scientific knowledge and its social problems. Clarendon Press, Oxford

Rushforth A, Franssen T, de Rijcke S (2019) Portfolios of worth: capitalizing on basic and clinical problems in biomedical research groups. *Sci Technol Hum Values* 44(2):209–236

Thompson C (2013) Good science: the ethical choreography of stem cell research. MIT Press, Cambridge, MA

Tuunainen J, Knuutila T (2009) Intermingling academic and business activities: a new direction for science and universities? *Sci Technol Hum Values* 34(6):684–704

Vertesi J (2020) Shaping science: organizations, decisions, and culture on NASA teams. Chicago University Press, Chicago

Walker J, Brewster C, Fontinha R, Haak-Saheem W, Benigni S, Lamperti F, Ribaudo D (2022) The unintended consequences of the pandemic on non-pandemic research activities. *Res Policy* 51(1):104369. <https://doi.org/10.1016/j.respol.2021.104369>

Whitley R, Gläser J, Laudel G (2018) The impact of changing funding and authority relationships on scientific innovations. *Minerva* 56(1):109–134

Woolgar S (ed.) (1988) Knowledge and reflexivity: new frontiers in the sociology of knowledge. Sage, London

Woolston C (2020) Pandemic darkens postdocs' work and career hopes. *Nature* 585:309–312. <https://doi.org/10.1038/d41586-020-02548-2>

Wróblewska MN (2021) Research impact evaluation and academic discourse. *Humanit Soc Sci Commun* 8:58. <https://doi.org/10.1057/s41599-021-00727-8>

Yan W (2020) Early-career scientists at critical career junctures brace for impact of COVID-19. *Science* <https://doi.org/10.1126/science.caredit.abc1291>

Acknowledgements

We are very grateful to all the participants who gave up their time to contribute to our study, and to all gatekeepers who provided invaluable help in recruiting for it. This research was funded in part by the Wellcome Trust [209519/Z/17/Z; WT106612MA].

Ethical approval

The qualitative instrument and methodology for this study were approved by SREG (Edinburgh Medical School) (26 February 2021). The research was performed in accordance with relevant guidelines from the British Sociological Association, and in accordance with the Declaration of Helsinki.

Informed consent

Informed consent was obtained from all participants.

Competing interests

The authors declare no competing interests.

Additional information

Correspondence and requests for materials should be addressed to Martyn Pickersgill.

Reprints and permission information is available at <http://www.nature.com/reprints>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

© The Author(s) 2022