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Pluralising critical technical practice

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Abstract
In this special issue, we turn to ideas of and approaches to critical technical practices (CTPs) as entry points to doing critique and doing things critically in digitally mediated cultures and societies. We explore the pluralisation of 'critical technical practice', starting from its early formulations in the context of AI research and development (Agre, 1997a, 1997b) to the many ways in which it has resonated and been taken up by different publications, projects, groups, and communities of practice, and what is has come to mean. Agre defined CTP as a situational, practical, and constructive way of working: 'a technical practice for which critical reflection upon the practice is part of the practice itself' (1997a: XII). Communities of practice in which the notion has been adopted, adapted, and put to use range from human–computer interaction (HCI) to media art and pedagogy, from science and technology studies (STS) and computer-supported cooperative work (CSCW) to digital humanities, media studies and data studies. This special issue affirms the pluralisation of CTP, and serves as an invitation to (re)consider what it means to use this notion drawing on a wider body of work, including beyond Agre. In this introduction, we review and discuss CTPs according to (1) Agre, (2) indexed research, and (3) contributors to this special issue. We conclude with some questions and considerations for those interested in working with this notion.

Keywords
Critical technical practice, internet studies, data studies, artificial intelligence, digital devices, digital methods, inventive methods, feminist STS

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How might technologically mediated practices be approached differently in light of critical theory, research, and reflection? How might critiques of software, computational devices, networked infrastructures, and digital data bear on how they are used or encountered? How might digitally mediated practices with troublesome histories and social lives be taken not only as objects of study, but as sites of critical engagement and experimentation? How can such encounters be taken as an invitation to live differently with digital technologies, whether through reforming, reassembling, rethinking, or refusing them? In this special issue, we turn to ideas of and approaches to *critical technical practices* (CTPs) as entry points to *doing critique* and *doing things critically* in digitally mediated cultures and societies. We explore the pluralisation of 'critical technical practice', starting from its early formulations (Agre, 1997a, 1997b) to what it has come to mean and the many ways in which it has resonated and been taken up by different publications, projects, groups, and 'communities of practice' (cf. Lave and Wenger, 1991).

In 1997, computer scientist Philip Agre introduced 'critical technical practice' (CTP) in relation to his dissertation research at the MIT AI Lab on 'reforming artificial intelligence' (AI), encouraging research and engineering work that moves between technological development and critical reflection on the epistemological implications of digital technologies (1997a and b). Acting on the observation that AI research and development in the 1980s primarily sought - though often failed - to combine philosophical and sociological concepts with mathematical principles in order to develop working computational models, Agre advocated inquiring into and reflecting on the history, empirical origins, and values of such concepts and principles (Ibid.). In particular, Agre questioned the uncritical use of metaphors in engineering practice (Agre, 1997a: 27–48) and encouraged a critical attitude *from within* practical work with and on computational technologies. Agre thus presented CTP as a deliberative and collaborative practice that brings critical sensibilities into the doing of technical work.

As a member of a computer science department and through his lively exchanges with the emerging computer-supported cooperative work community, Agre was a lucid commentator of the growing ubiquity of computation (i.e. networked technology and applications of computational automation and AI) in and its impact on everyday life (1997a: 312–315). In this sense, Agre was an early 'internet scholar [...] who grew increasingly worried about the consequences that communication technologies were having on people's privacy' (Masís, 2014), culminating in his work on 'surveillance and capture' in public and workplace settings (Agre, 1994). This work has been taken as an important contribution to the formation of surveillance studies (cf. Wood 2009; Wood 2022). Agre's work has been drawn upon in studies of agency in relation to computational infrastructures and the (pre-)structuring of human action in social media spaces and other areas of algorithmically mediated culture (e.g. Gerlitz and Rieder, 2018; Gekker and Hind, 2020; Sprenger, 2019). While Agre argued for endogenous ways of rethinking and re-developing AI, his stance towards such technologies was not optimistic. For example, he was an early critic of facial recognition technologies, contending that they should be abandoned rather than reformed (Agre, 2001).

In today's research, we face ubiquitous computing infrastructures akin to those that concerned Agre. Attempting to grapple not just with the social world and cultural artefacts, but also with the digital technologies that mediate the phenomena under scrutiny has become a challenge especially in less technically oriented disciplines. Digital devices and infrastructures serve as knowledge technologies with social, economical, and political implications, which media researchers and practitioners should not only study but also intervene in and interfere with (cf. Bunz, 2021; Rieder and Röhle, 2017). Yet, the question is how.

As this introduction to the special issue on 'Critical Technical Practices in Digital Research' examines, CTP has been taken as an inspiration for *doing technical practices critically* across

different fields, from human-computer interaction (HCI) to media art and pedagogy, from science and technology studies (STS) and computer-supported cooperative work (CSCW) to digital humanities, media studies and data studies. We pose questions about what it means and implies to draw on CTP in the current moment. How has it been cited, adapted, put to work, elaborated on, and operationalised by those inspired by it? What are its prospects and limits? How does it conceptually carve things out into critique, technique, and practice? How might we re-read and re-situate CTP beyond Agre in relation to other critical engagements with technologically mediated practices, such as feminist, queer, anti-racist, decolonial, community-centred, and ecological approaches? How might CTP imply particular distributions of agency and configurations of relations between researchers, technologies, texts, cultures, and communities of practice, and with what consequences?

This special issue affirms the pluralisation of CTP, and serves as an invitation to (re)consider what it means to use this notion in relation to a wider body of work, including beyond Agre. In this introduction, we review and discuss CTPs according to (1) Agre, (2) indexed research, and (3) contributors to this special issue. Drawing on this, we gather some initial questions and considerations for those wanting to work with this notion.

CTP according to Agre

Philip Agre wrote about the approach of critical technical practice (CTP) in the volume Computation and Human Experience (1997a), and introduced CTP in a book chapter for an STS audience in the same year (Bowker et al., 1997). The term arose in the course of his journey from computer scientist, in the field of artificial intelligence (AI) research and development, to science and technology studies (STS) scholar. He arrived at CTP through his own process of 'waking up' into 'full-blown dissidence' with the help of 'people who claimed to be able to explain what is wrong with AI' such as Hubert Dreyfus and Lucy Suchman and texts they suggested from Heidegger, Foucault, and Garfinkel (Agre, 1997b: 144, 146, 147). This took place in tandem and following his dissertation research, in which he struggled with investigating and formalising the structure of everyday human activities and their relation to cognition in the context of developing AI models.

Disillusioned with the 'intellectual conservatism' of AI, its focus on the 'internal resources of the field' (Agre, 1997b: 145, 150), and its limited historical and societal context with respect to the formulation of problems, Agre sought to look outside the field for inspiration regarding alternative paths, possibilities, and perspectives. Alongside his readings of 'non-technical' texts as a source of critical perspectives on the limits of AI, he also strove to attend to everyday 'hassles': 'small bits of trouble that recur frequently in routine patterns of activity' (Agre, 1997b: 146). While these accounts of problems and 'foreign disciplinary languages' (Ibid.: 148) supported Agre in articulating more fundamental problems with AI, they did not help to convey these to colleagues in the field:

> When I tried to explain these intuitions to other AI people, though, I quickly discovered that it is useless to speak nontechnical languages to people who are trying to translate these languages into specifications for technical mechanisms. This problem puzzled me for years, and I surely caused much bad will as I tried to force Heideggerian philosophy down the throats of people who did not want to hear it. Their stance was: if your alternative is so good then you will use it to write programs that solve problems better than anybody else's, and then everybody will believe you. Even though I believe that building things is an important way of learning about the world, nonetheless I knew that this stance was wrong, even if I did not understand how. (Agre, 1997b: 149)

In this sense, CTP arose as a way of 'attempting to reform the field [of AI] by providing it with the critical methods it needed' (Agre, 1997b: 132). It is construed as an attitude for working both with, on, and about computational technologies with 'one foot planted in the craft work of design and the other foot planted in the reflexive work of critique' (1997b: 155). Agre argues that '[s]uccessfully spanning these borderlands, bridging the disparate sites of practice that computer work brings uncomfortably together, will require a historical understanding as a resource in choosing problems, evaluating solutions, diagnosing difficulties, and motivating alternative proposals' (Ibid.).

While AI critique could be formulated *from without*, CTP aims at identifying, articulating, and translating problems in the field as an attempt to reform AI *from within*. Agre defined CTP as a situational, practical and constructive way of working: 'a technical practice for which critical reflection upon the practice is part of the practice itself' (1997a: XII). Agre did so, amongst others, in his collaborations with David Chapman and exchanges with Lucy Suchman, critiquing a focus in AI research on specific conceptualisations in the cognitive-behavioural sciences that he addressed as 'mentalism' (Agre, 1997a: 49–65): That is, his intervention aimed at challenging the common assumption of following preconceived plans step-by-step (mentalism), instead contending that the relation between human cognition and action is *situational* and *interactional*, improvising and adapting action possibilities based on how environments and other actors are encountered. The CTP demonstration came through the development of 'Pengi', an AI implementation capable of playing computer game 'Pengo', 'engag[ing] in complex, apparently planful activity without requiring explicit models of the world' (Agre and Chapman, 1987; see also Agre, 1997a: 260–301). In Pengi, Agre and Chapman devised an approach to AI that resonates with the notion of 'situated action' (cf. Suchman, 1987).

Agre's writing embodies and advocates a 'hybrid' textual approach, combining 'technical and critical genres of writing' (1997a: XIII). He suggests that writing for 'both the technical and critical audiences for this book' implies 'reckoning with the very different genre expectations that technical and critical writing have historically entailed'. Agre argues that 'technical texts … are generally understood to report work that their authors have done', offering solutions to formulated problems, 'focused on machinery' and in a manner 'that others can replicate, closing the technical demonstration by means of an outlook, which addresses future problems to be solved'. Critical texts, Agre states, 'open by situating a problematic in an intellectual tradition, and they proceed by narrating their materials in a way that exhibits the adequacy of certain categories and the inadequacy of others' (Agre, 1997a: XIII). Contributors to this special issue take up the challenge of combining writing for audiences in the humanities and social sciences with more technical genres in computer science and engineering – a synthesis which has become important for empirically informed cultural and social research on digital media.

What can be made of Agre's accounts of CTP today? Agre's critiques focused on problems with so-called 'symbolic AI', – an approach to AI centred on rules of logic derived through the formalisation, modelling and representation of human knowledge and reasoning (Woolridge, 2020). Recent accounts of the development of AI, however, emphasise a paradigm shift to 'connectionist', data-intensive and more task-specific approaches (Ibid.; Cardon, 2019). Contemporary AI discourses and applications centrally feature machine learning approaches (Hao, 2019) based on large training datasets and 'computationally inflected environments' characterised by 'ubiquitous testing', including in real-world settings (Marres and Stark, 2020). The kinds of problems surfaced by the role of technologies and technical expertise in society may be different both in scale, sites, and character to the kinds of problems Agre had in mind when working on CTP. CTP was formulated in the late 1990s in a particular milieu of writing and thinking about technology, particularly in relation to fields such as philosophy of technology,

science and technology studies (STS), computer-supported cooperative work (CSCW), and human–computer interaction (HCI) (cf. Bowker et al., 1997; Suchman 1987).

One can talk of CTP 'after Agre' in the sense of drawing inspiration from this work in the late 1990s in relation to our contemporary situation. In another sense, we may talk of CTP after Agre, as (since 2009 and as of the time of writing) he has withdrawn from public life (cf. Carvin, 2009; Masís, 2014). In the next section, we examine how CTPs have been mentioned, adopted, adapted, and operationalised in academic work and on the web by various communities, attending to the ways in which the notion has been, at least to some extent, pluralised, and diversified.

CTPs according to indexed research

What has become of CTP according to indexed research? With a broadly genealogical sensibility, references and materials we retrieved through literature review were not used to retrace 'unbroken steps of transmission to a singular origin' (Geuss, 1999). Rather, our aim was to look for the different and possibly diverging ways in which CTP has been taken up. We encountered many ways in which CTP is mentioned – at times in passing. These mentions and references serve different purposes: to indicate positioning or alignment, as an aspirational association, or as part of a group of concepts which indicate attempts to think critically and do things differently. As one recent workshop on 'tracing critical technical practice' put it: 'Since the publication of Phil Agre's seminal work on critical technical practice, the sites of intersection between computation and society have multiplied, and so too have the sociotechnical borderlands we inhabit' (Lindtner et al., 2015). In tracing the 'social life' of CTP (cf. Ruppert et al., 2013), we did not only strive to delineate the settings in which it surfaced, but to sketch the diversity of its recent meanings, uses, and practices. The underlying aim is to situate CTP: that is, to understand what the term has been taken to mean, how it has been used and what it has inspired – as well as tracing the kinds of communities, forms of critique, and technical practices in relation to which it has resonated.

To get a sense of its trajectories, and making an effort for source triangulation, we queried for the term ['critical technical practice'] in different libraries such as Scopus, the Web of Science, the Association for Computing Machinery (ACM) Digital Library, and the Google Scholar search engine. Each of the queried resources returned overlapping, but mostly diverging results, and employed different ordering mechanisms. The ACM Digital Library gave a sense of how CTP resonated in more technical fields such as human–computer interaction (HCI) and interaction design, where we knew Agre's work was taken up early on (cf. Suchman 1987, 2007; Dourish et al., 2004; Sengers et al., 2006). Scopus, Web of Science and Google Scholar returned results from a wider variety of fields, with Google Scholar being the most diverse. While Scopus and Web of Science returned primarily article publications in peer-reviewed journals, Google Scholar also featured book (chapter) publications, and thus, provided access to the ways in which CTP has been taken up in fields in the humanities and social sciences.[1] We also queried Google Search results to get a sense of how the term had been used in reports, blogs, and materials that may not have been indexed in these other resources.

Not surprisingly, some of the earliest references to CTP are from anthropologist and feminist STS scholar Lucy Suchman. In the 1987 edition of her *Plans and Situated Actions*, she mentions Agre in the acknowledgements in relation to exchanges at the Xerox Palo Alto Research Center where they had met. The 2007 edition of the book elaborates on these earlier exchanges, describing how Agre and Chapman were 'engaged in a kind of endogenous critique of prevailing assumptions and practices within the field' – and how they appreciated finding common cause with an 'anthropologist engaged in the same project' from the perspective of everyday practice, who in turn was

'delighted to find allies capable of opening up the planning framework to critical inspection on its own terms' (Suchman, 2007: 14). This characterisation of CTP as 'endogenous critique' and 'critical inspection [of aspects of a field] on its own terms', is also reflected in a piece Suchman wrote on 'critical practices': She discusses how Agre encouraged 'new genres not easily identified either as insider texts or outsider critiques' and contended that 'respectful critique requires the incorporation of critical reflection as an indigenous aspect of professional practice' (Suchman, 1999: 13). CTP is here envisaged as critique formulated in ways which are relevant and related to professional practices and draw upon the epistemic resources of technical insiders.

CTP was also taken up after Agre's 1997a publications in the work of Phoebe Sengers. In her PhD dissertation (Sengers, 1999), she reads Agre in terms of how technical fields can meaningfully engage with and incorporate insights from critical and cultural research: Sengers writes that 'a critical technical practice is a way of actually doing AI which incorporates a level of reflexive awareness of the kind espoused by science studies' which 'may include awareness of the technical work's sociocultural context, its unconscious philosophies, or the metaphors it uses' (Sengers, 1999: 30). She provides 'A Short History of Critical Technical Practices' before Agre, such as engagements with Heidegger in AI research (Winograd and Flores, 1986). Here, the emphasis is placed on 'doing AI' as technical practice, and Sengers raises questions about how practices relate to different kinds of technically engaged communities, including not only computing professionals, but also artists and researchers of culture and society. She calls for expanding who can do CTP beyond computer science, giving the example of new media art 'when artists build complex computational systems (i.e. artworks) which are informed by critical reflection on technology and its role in society' (Sengers, 1999: 58). According to Sengers, the making of such digital art is affirming the blurring lines between 'technical practice, artwork, and cultural studies' and the prospects of 'a new interdiscipline' which generates 'technical artefacts that enrich human experience, rather than reducing it to a quantified, formalised, efficient, and lifeless existence' (Ibid.). In a similar vein, Sengers et al. (2002) draw on the notion of CTP in proposing an 'enigmatics of affect': 'a critical technical practice that respects the rich and undefinable complexities of human affective experience' (87). Some of the contributions in this SI relate to this conception of CTP, for example, aiming for creative and artistic engagements with AI techniques (e.g. Sánchez Querubín and Niederer, 2022).

A notable moment for the reception of CTP in the field of Human-Computer Interaction (HCI) is a workshop in 2004 in Vienna on 'reflective HCI'. In the workshop introduction, CTPs – already addressed in the plural – are said to be characterised by the view that 'technology development is not simply an end in itself' but rather 'a means to reflectively explore the assumptions and attitudes that underpin ideas about technology and humanity' (Dourish et al., 2004: 1727). In the context of HCI, the organisers Paul Dourish, Janet Finley, Phoebe Sengers, and Peter Wright (2004) suggest CTP can be taken as 'ways to integrate exploration of the fundamental assumptions underlying current interaction design practice with the development of new forms of interaction design' (1727). The introduction to the workshop takes CTP as a generative lens to review a range of practices and projects in HCI which may not explicitly self-describe as CTP. Notably, as indicated in Sengers's previous work, this includes artistic engagements with technology which raise critical questions – such as 'questioning our notions of the role and disposition of the body in human-computer interaction' and 'reflecting on relationships between audience and narrative' (Dourish et al., 2004 in reference to Mateas and Sengers 2000, and Penny et al., 2001). Another paper in the workshop proposes '[t]he Uncanny as strategy for a critical approach to the design of robots' (Dourish et al., 2004: 1).

In the extended abstracts of the same 2004 workshop, researchers also suggest looking beyond a focus on how researchers and technical communities reflect on assumptions underlying their

technical practices towards critical encounters and reflection by *users* – proposing 'reflective design' as a companion term which extends CTP. Here, Kirsten Boehner, Geri Gay, Phoebe Sengers, Timothy Brooke, and Xiaowen Chen (2004) present Agre's CTP as 'critical reflection [...] dialectically linked with technical research through the researcher's reflection on his or her own work', and 'reflective design' as 'reflection not only by researchers but also by users' (4). The relation between CTP and reflective design is further elaborated in a 2005 paper (Sengers et al., 2005). The paper describes how CTP as a *method* for reflective design is extended in three ways: First, users reflect on the design of technology and their use of technology rather than only designers reflecting on their practice. Second, employing a critical attitude throughout the entire process of design, not just at an impasse or during breakdown moments. Third, critical reflection as something driven also by critical concerns rather than only technical ends (Sengers et al., 2005: 52).

Sengers and Dourish also collaborated with John McCarthy (Sengers et al,. 2006) on a workshop paper in which they sought to formulate an agenda for critical practice in reflective HCI. While the paper acknowledges the influence of Agre on HCI discourse and particularly the work that metaphors do, 'critical practice' is presented as a broader agenda in HCI (Ibid.). A decade later, Vera Khovanskaya et al. (2015) look back and outline the different ways in which CTP has been picked up within HCI – including 'as a core method throughout all phases of technology's design and use', as a way to 'integrate criticism and critical theory into design', and 'to articulate and execute critical approaches to interaction design' (53).[2]

While the above-mentioned early HCI papers are already concerned with questions of values in technology development (e.g. Sengers et al., 2005, 2006), almost a decade later CTP is explicitly coupled with notions of and approaches to value-centred or -sensitive design (cf. Shilton, 2013). HCI researchers who represented the stance of 'values in design (VID)' (e.g. Knobel and Bowker, 2011) emphasised 'that the values and impacts of technology are often unintentionally built-in' early on in a technology design process (Rubambiza et al., 2022: 12). Therefore, Gloire Rubambiza, Phoebe Sengers, and Hakim Weatherspoon's (2022) VID-inspired approach has been concerned with 'develop[ing] means for technology designers to productively identify and engage with issues related to societal impact in the early stages of technical design' (12). Rubambiza et al. (2022) mobilised CTP to realise their VID approach observing and intervening in an infrastructural 'digital agriculture' project in a rural area. In their reflections with the involved researchers, they built on their observation of the co-existence of and tensions between these researchers' technological 'visions of seamless interoperability' and their 'seamful realities of colliding into a host of material resistances' (Rubambiza et al., 2022: 12). Advocating 'more artful management of seams for end users, enabling [digital agriculture] infrastructure to be better adapted to and appropriated in the farming context', the authors demonstrated the advantage of situating critical reflection on societal impacts of such infrastructural technologies throughout their development and implementation, creating visibility for the 'downstream consequences of developers' everyday experiences' (Ibid.).

In recent work in the field of STS, CTP has also been taken as a form of 'inventive engagement' (Vertesi et al., 2017: 176). If HCI researchers view CTP as a way to bring critical reflection from technology makers and users into design processes, STS researchers discuss CTP as a way to bring 'STS principles into digital artifacts', alongside other approaches which aim to 'accommodate excluded user communities, embody alternate value frameworks, or inspire reflective critique' (Vertesi et al., 2017: 176).

Agre and CTP have also been influential for art-based and pedagogical work conceptualised as 'critical making' by, among others, Matt Ratto (2011). Ratto remarks that critical making, with its focus on critique rather than technical savviness, has a lot in common with work in the area of HCI. He makes explicit reference to critical technical practice (Agre, 1997b), critical design (Dunne, 2005), and

reflective practice (Sengers et al., 2005). However, critical making differs from these examples because it is centred on 'shared acts of making' and its explicit engagement with concepts and theories from literature facilitating broader reflection on the role that digital technologies play in society.[3]

The influence of Agre's work on critical making becomes more explicit in the *Critical Makers Reader: (Un)learning Technology* (2019) edited by Loes Bogers and Letizia Chiappini. The volume addresses a particular strand of CTP that was taught at Goldsmiths University of London's Cultural Studies Department. This strand is defined in terms of 'the formation of thought and action that incorporates art as a method of enquiry into particular sociotechnical milieu' (Bogers and Chiappini, 2019: 32). In art practice, Winnie Soon and Geoff Cox (2020) suggest that CTP has inspired their notion of 'aesthetic programming': 'a practice to build things, and make worlds, but also produce immanent critique drawing upon computer science, art, and cultural theory', which aims 'to further "queer" the intersections of critical and technical practices' (15).

In the context of new media and digital humanities research, Rieder and Röhle (2012, 2017), discussed CTP as a way to study and scrutinise the epistemic implications of 'machine mediation' and 'to build a critical understanding of the infiltration of software into every pore of contemporary society' (2012: 82). CTP is mentioned as an 'involved' approach 'that oscillates between concrete technical work and methodological reflexivity' (Rieder and Röhle, 2012: 80), to unpack the concepts, assumptions, and forms of knowledge embedded and 'mobilized in digital tools' (Rieder and Röhle, 2017: 111). In a special issue on 'the shadows of the digital humanities', Michael Dieter (2014) contends that the 'repositing of problems' is central to CTP, referring to Michel Foucault's work on problematisation, as well as the problematising practices of new media artists (218). Dieter argues that CTP in this context marks Agre's role as bridge-builder between the humanities and computer science, advocating not only collaborative, but also interdisciplinary exchanges between diverse scholars and practitioners (Dieter, 2014: 2017). Some contributors to this issue elaborate on the implications and challenges of interdisciplinary research in the spirit of CTP, if interdisciplinarity is taken seriously (Hirsbrunner et al. (2022) in this issue).

In data studies, CTP has been taken as inspiration for 'critical data practice' – including exploring 'what difference critical studies can make in doing things with data' (Gray, 2018: 13); 'how critical, historical and sociological reflection on data infrastructures can be folded back into practical data work' (Gray et al., 2018: 4); and 'how critical engagements with data might modify data practices, making space for public imagination and interventions around data politics' (Gray and Bounegru, 2021: 14; cf. Gray et al., 2016). Critical data practice in this regard is well-aligned with more recent work in what has been called 'critical data studies' to not just emphasise the importance of studying how technological developments and social processes are entangled and influence each other mutually, but also advocate a situated stance approaching and following data practices in the (micro-) situations and the cross-situational ways in which they evolve (Bates et al., 2016; Tkacz et al., 2021; cf. also Burkhardt et al., 2022). In this special issue, the idea of critical data practices is taken up reflecting on the design efforts needed to devise situations that allow for such practices (cf. Madsen (2023) in this issue).

More recently, CTP has also (re-)surfaced in relation to critical engagements with AI – including attempts from computer scientists and industry researchers to 'reform AI' in various ways. In work on how to design Explainable AI (XAI), CTP is proposed as a way to 'question [...] core epistemic and methodological assumptions' of XAI (e.g. 'what perspectives are we missing?' and '[h]ow might we incorporate the marginalized perspectives to embody alternative technology?') as well as to 'generate alternative technology that brings previously-marginalized insights into the center', including the social aspects of explainability (Ehsan et al., 2021: 2, 24). Such efforts resonate with more recent engagements around CTP in HCI, including calls for an 'anti-racist HCI' (Abebe et al.,

2022). Veronica Abebe et al. (2022) argue for HCI research that 'centers anti-racism at its core' (2) by 'bring[ing] techniques from critical technical practice to bear on revealing and inverting assumptions in HCI' and 'attempting to produce alternative sociotechnical systems that aim not merely to reveal or correct but to destabilize or dismantle systems of oppression' (1).

In their call for 'Decolonial AI', Mohammed (2020) propose 'infusing CTP with decoloniality', to look beyond 'good-conscience design and impact assessments that are undertaken as secondary tasks' towards 'a way of working that continuously generates provocative questions and assessments of the politically situated nature of AI' (672). This paper is an example of contemporary AI critique, partially formulated *from within* tech industries (at the time of writing two of the three authors worked at big tech company Alphabet's DeepMind AI research laboratory). As the current critique of the risks of and biases in AI and related firings demonstrate, with Timnit Gebru as maybe the most prominent example,[4] formulation of critique from within tech industries can be fraught, to say the least. Some of the contributors to this special issue also discuss the possibility of 'ethics washing' through particular forms of technical criticality (ab)used by tech industry players for whom the organisational bottom line is corporate interests, which may limit critical engagement related to broader societal issues (see Hind and Seitz (2022) in this issue).

From this brief cross-disciplinary review we can see a plurality of ways of thinking and doing CTP. In certain contexts CTP features simply as conceptual companion, appearing listed with associated concepts such as critical making and value-sensitive design. Moreover, one can see how CTP travels apart from its original association with Agre and has been taken as a more open-ended and multivalent invitation to do technologically or computationally mediated things critically. We detect different emphases on what CTP is envisioned to contribute, which depends on the conversations, assumptions, problems, and ways of working in the field or community in which it is being invoked. For example, in the context of AI research, it was envisaged as a way to formulate critique making it relevant to communities of technical fields; in HCI, it may be taken as a way to bring critical sensibilities into design; in STS, it may be taken as a way to bring STS perspectives to interventions with technical communities and practices; in art and making, it may be envisaged as a way to highlight how arts-based methods may intervene with technologically mediated systems; in media studies and humanities, it may be taken as a way to surface problems with and assumptions of digital technologies through hands-on engagements with devices and infrastructures (not just texts); in the context of computer science and engineering, it may be taken as a way to show critique is taken seriously in the face of broader societal concerns. As well as these different disciplinary orientations, critique has been pluralised beyond a particular critical canon, towards evolving relational sensibilities taking into account multiple and intersecting forms of marginalisation, exclusion, and oppression that may surface around science and technology in society.

CTPs according to special issue contributors

This special issue engages with CTP in the context of research, teaching, and broader societal engagement around digital devices, computational tools, and infrastructures. It is prompted by recent calls advocating the relevance of such approaches to research and tool development in cultural and social studies in order to approach digital media as both objects and instruments of investigation (e.g. Bunz, 2021; Dieter, 2014; Gray et al., 2018; Gray and Bounegru, 2021; Rieder and Röhle, 2012, 2017; van Es et al., 2021; van Geenen, 2020). In the spirit of pluralising CTP and rendering visible this pluralisation work, we conceive of this concept as a 'boundary object' (Star and Griesemer, 1989), employed as a social connection point for exchange between the scholars who contributed to this special issue. As a way to establish this exchange, we held a half-day

workshop in February 2022, in which contributors engaged with each other's work on CTPs in different research and technical contexts. In what follows, we gather together and introduce the different articles in this special issue, highlighting some of what they contribute to thinking about and engaging with CTPs.

The contributions to the issue can be clustered into four overlapping approaches: *social lives of critique*, *eliciting criticisms*, *accounting differently,* and *reflexive making*. This clustering was designed to facilitate connections and convergences across the papers. Collectively, the papers illustrate a plurality of CTPs as it is found in diverse contexts and is brought to bear on different audiences (e.g. tool makers and tool users; but also diverse academics, professionals, and students). The contributions offer different ways of thinking about the critical, the technical, or what constitutes practice, and the diverse relationships and tensions between these notions. What binds them is their recognition and engagement with the fact that technology *is* culture, and accomplished in and through cooperative social practices.

The section 'Social Lives of Critique' – hinting at Ruppert and colleagues' (2013a and b) notable calls to acknowledge and inquire into the 'social life of methods' and devices – features papers that focus on criticality within different professional settings and situations in which digital, algorithmic, and data technologies play a central role. In 'Cynical technical practice: From AI to APIs', Sam Hind and Tatjana Seitz (2022) detect and scrutinise a 'narrow' understanding of technical criticality used in the tech industry, ostensibly in service of social transformation, but in fact serving their corporate agendas. Drawing on the work of Agre, they argue that rather than a lack of technical criticality, tech industry workers are – still – too occupied with 'work-ability' focusing on only those theories that can be applied in a technical sense. The authors render such 'cynical technical practice' – which is, as they note themselves, not presented as necessary an antonym of CTP – visible in examples from the context of (social media) application programming interfaces (APIs) and AI development in relation to autonomous driving, striving to spark more analyses of how technical criticality involves and fosters certain forms and structures of power. Subsequently, 'Interface critique at large' by Michael Dieter (2022) offers a historical problematisation of interface design. The chapter explores domains of practitioner-based interface criticism that have been inspired by Agre's formulation of CTP such as reflexive design and software art, diagnosing disconnections of such critical technical cultures in HCI with industry-led design practices. Building on software studies and media theory, Dieter (2022) introduces what he calls a 'navigational matrix' addressing modes of interface critique including identifying traps and enclosures, revealing asymmetries, and eventually arriving at developing metacritical alternatives to assess interfaces' mundane impact taking all these factors into account. The contribution 'Re-enacting machine learning practices to enquire into the moral issues they pose' proposes and explores eliciting methodologies applying an interview protocol for the re-enactment of machine learning practitioners' daily practices. John-Mathews et al. (2023) aim of introducing the experimental interview setting at a credit scoring company is to create an environment in which ethical considerations can be addressed paying attention to the complexity of technical, legal, and organisational entities at play. This methodological intervention concerns a process of slowing down, generating hesitation, and interrogation, for the purpose of appealing to the involved actors' methodological reflexivity. It re-engages the practitioners with their technical tools, aiming for regrounding moral issues in ML technology development, and the development of situated CTPs within ML-developing professional environments.

'Eliciting Criticisms' groups the contributions concerned with practical interventions that elicit or stage criticism. Anders Koed Madsen's (2023) 'Digital methods as experimental a priori: – how to navigate vague empirical situations as an operationalist pragmatist' sketches the critical potentials

of the multivalent empirical world that digitalisation and computation produce, discussing his work with actors in urban planning projects. From a pragmatist perspective on critical enquiry, he proposes design principles for a critical data practice that takes operationalisations, measurements, and algorithmic techniques as valuable tools for exploratory empirical investigations. The argument is supported by ethnographic material from two years of data experiments with GEHL architects discussing the collective work with 'digital methods' (Rogers, 2013) and Facebook data. Taking such methods and data as 'experimental a priori', Madsen advocates the need for design interventions in this work, on the one hand, to assess the meaning of existing concepts such as the idea of urban space, and on the other, to repurpose central algorithmic techniques to re-evaluate the core assumptions they propagate such as in light of (missing) diversity. Winnie Soon and Pablo Velasco's (2023) contribution '(De)constructing machines as critical technical practice' discusses how they adopt CTP as a didactic approach in their teaching. The authors provide insight into teaching activities and methods performed with students in humanities courses for constructing computational artefacts and deconstructing digital tools. Practically manipulating software and data is used as a means for critical and embodied reflection on both the technical and sociocultural domain. The critical here is understood as adopting a critical position. Mathieu Jacomy and Anders Munk's (2022) article 'Interfering with the black-box-tradeoff model: Gephisto, a one-click Gephi for critical technical practice' presents an example of tool design conceived of as a CTP. Their experimental tool Gephisto visualises networks in one click not requiring users to make any decisions. Rendering unpredictable visualisations, Gephisto's goal is to make users aware of the implicit decisions that shape the network map and its interpretation. The authors oppose the idea that ease-of-use and critical thinking are at odds arguing that users need tools that support both and that these can be built.

The contributions clustered as 'Accounting Differently' raise questions about how digital devices and tools and their making play a role in academic practice and how to make them 'account-able' (Garfinkel, 1967: 1) through documentation and reflection practices. Urszula Pawlicka-Deger's (2022) 'Feasibility documents as critical structuring objects: An approach to the study of documents in digital research production examines 'feasibility documents' produced by King's Digital Lab.[5] These documents capture the lab workflow and management. By conducting a 'feasibility analysis' of these documents, Pawlicka-Deger (2022) unpacks the social, technical, and management issues that arise in the process of creating digital artefacts within the context of the Digital Humanities, also aiming at offering a methodological framework for the analysis of documents produced in this field and posing questions about the sociotechnical quality of digital production. Ogden et al. (2023) paper 'Know(ing) infrastructure: The Wayback Machine as object and instrument of digital research' reports on a pilot project concerned with documenting the inner-workings of 'Save Page Now' (SPN), an Internet Archive tool that allows users to initiate the creation and storage of 'snapshots' of web resources. Considering SNP in the context of documenting human rights abuses, the authors engage with the relationship between how digital infrastructures create new knowledge about the world, their implications and the new methodologies needed to understand them for a meaningful interaction. From a digital STS perspective and advocating an interdisciplinary examination of SNP, the authors discuss the need for a situated and material perspective on such knowledge infrastructures, but also associated challenges such as temporality, scale, visibility, and the researchers' positionality. The paper 'From critical technical practice to reflexive data science' by Hirsbrunner et al. (2022) proposes 'reflexive data science' (RDS) as a methodological entry point for interdisciplinary engagement with ML, by means of the case of YouTube research enhanced by content modelling. Connecting Niewöhner's idea of 'co-llaboration' to CTP, the article aims at making disciplinary frictions and other diverging positions productive for critical investigation. As the building blocks of RDS, the authors address: a)

arranging encounters of social contestation, b) infrastructuring devices facilitating reflection, c) negotiating emerging matters of concern, d) and designing for reflection.

The papers in 'Reflexive Making' focus on actively engaging in the making of computational methods and tools, and the role of criticality therein. Rieder et al. (2022) contribution 'From tool to tool-making' addresses tool-making as a form of authorship. Tools and tool-making have profound influence on research practices. Drawing from their own experiences as tool makers in social media research, they expose four interrelated issues when this authorial role becomes visible: 'Tool-making' is discussed using the examples of four social media research software projects and infrastructures that the authors were actively involved in building, from the perspectives of co-development, maintenance and care, and ethics by design, paying particular attention to systemic and institutional issues when it comes to the sustainability of research software tools. Chao et al.'s (forthcoming) article also tackles the importance of reflexive tool(-)making for current digital media research. 'Digital methods for sensory media research' addresses the possibilities of and discusses the limitations to developing medium-specific, 'digital methods for studying mobile sensory media such as smartphones and their apps by turning to CTP. Such digital devices are highly contingent and increasingly obfuscated objects of study due to frequently updated and customised media infrastructures on which they thrive and depend. Yet, due to their prominence in mundane practices and their capacity to continuously and unnoticably monitor everyday (inter)activity, it is essential to study mobile sensory media as entangled infrastructures. Introducing toolmaking as a specific form of CTP, the authors advocate 'repurposing' these media's functionality and data, including through app developers' entry points. They present two 'toolmaking stories' explicating opportunities for and challenges of examining app code inquiring into sensor data access of mobile devices, and of 'sensing' and exploring network connections apps invoke, which are at the heart of these devices' functionality. Toolmaking and accounting for this process in the context of sensory media studies becomes a vital part of media research and critique.

Lastly, we shift focus from building tools and exploring existing digital media infrastructures to creative and 'inventive' (cf. Lury and Wakeford, 2012) uses of AI. In the articles in this subsection of 'Reflexive Making', AI is not just employed, but also questioned through its application. Daniel Chávez Heras's (2023) article '*Creanalytics*: Automating the supercut as a form of critical technical practice' offers insight into the prototype of a computational system that automates the supercut, a cinematic technique. Through the application of ML techniques, it produces short compilation videos from a large dataset of film clips. The system allows for technical exploration not only through annotating moving images, but also, the production of new images, making visible where computer vision is insufficient and breaks down. Sánchez Querubín and Niederer's (2022) contribution 'Climate futures: Machine learning from cli-fi' explores an artistic research project in which ML, trained on climate fiction novels, is prompted to produce new climate stories and climate-related images. The purpose of the project is to elicit reflections on living with climate changes, both present and future. The collaboration with this form of AI creates glitches, opening up and defamiliarising common descriptions of climate change, as well as offering a playful way of engaging with ML's assumed predictive capacities.

Considerations: CTP beyond Agre

CTP is, as we have sought to emphasise in this introduction, done in different ways and means different things to different communities of practice. This special issue (re)affirms this pluralisation in providing a stage to scholarly research that features working attitudes imbued by CTP and/or doing and designing CTP-inspired projects. In the remaining part of the introduction, we would like

to take a step back from the readings of and applications to CTP presented above and move forward formulating some considerations for doing CTP beyond Agre along the lines of four central concepts closely connected to this concept: that is, critique, the technical, practice, and reflexivity.

What is critique?

What is meant by critique? Where does it come from? Who and what is involved? How is it accomplished, performed, and materialised? For what and for whom? Agre presents critique as a collaborative and deliberative process of exchange across disciplines. He writes that:

> [t]he word 'critical' does not call for pessimism and destruction but rather for an expanded understanding of the conditions and goals of technical work. [...] Instead of seeking foundations it would embrace the impossibility of foundations, guiding itself by a continually unfolding awareness of its own workings as a historically specific practice. [...] It would accept that this reflexive inquiry places all of its concepts and methods at risk. And it would regard this risk positively, not as a threat to rationality but as the promise of a better way of doing things. (Agre, 1997a: 22-23).

Here, to be critical is not just to disapprove, or to judge, but also and foremost to be aware of background conditions, of attunements to specific social, cultural and historical circumstances. Critique is envisaged not just as something which takes place in relation to fixed conditions (measuring up against that which may be known in advance), but in relation to changing circumstances and communities. Such a pluralised and relational conception of critique is also found in Thiele et al.'s (2021) edited volume 'The Ends of Critique', which advocates the 'necessary revision of critique as method and move towards a situated, perspectival, and entangled critique' (Kaiser et al., 2021: 6).

While critique may be seen as a way to 'step back' – CTPs illustrate that it may also be accomplished through delving in. As indicated by the notion of 'immanent critique', critique can come from a surfacing of tensions within the conventions and assumptions of a community of practice (cf. Diehl, 2022). In the workshop we held with the contributors to this issue, we discussed the value of 'critical proximity' (Latour, 2005 in Madsen and Munk, 2019) for cooperative research design and tool development work, as a means of slowing down (cf. Stengers, 2018), connecting and collaboratively reflecting with other involved actors, including with 'users' and 'publics' of digital and 'data-intensive' environments, technologies, and infrastructures. Critique may be construed in terms of processes of problematisation: the surfacing of more fundamental tensions and issues, beyond bugs to be fixed and, amongst others industry-led incentives to solve social problems through technological innovation (cf. Hind and Seitz (2022) in this issue). Such problematisations have been proposed to lead to disenchantments and 'awakenings' (Malik and Malik, 2021) as well as bigger shifts in ways of thinking or relating to technologically mediated practices and systems (cf. also Dieter (2022) in this issue).

As we hope to illustrate with this issue, critique needs not only be articulated through text-based, discursive modes of particular academic or intellectual formations – but also through the arrangements of a plurality of a different actors, concerns, formats, conventions, materials, and techniques. Those interested in drawing on CTPs may thus consider how critique is formulated and materialised through particular kinds of arrangements, for whom and to what end.

What is technical?

What is technical? What counts as technology? Who and what is involved in the technological, and what is considered technique? What kinds of delegation of agency and responsibility accompany different conceptions of technology and technique? When and in what kinds of situations are things presented as technical?

While the notion of CTP arose in the context of artificial intelligence research, where the interest was how problematisations could be formulated in ways which were in the first place relevant to technical communities, as above reviews and summary of the issue have shown, the concept has also been taken to refer to many different kinds of technical and technologically mediated practices. Alongside the practices of expert technical communities like software developers, one may also consider different forms of everyday expertise and media technologies (cf. Soon and Velasco (2023) in this issue). Media theorists have long argued for more expansive understandings of media and infrastructure – including not just large technical systems, but also the technical mediation of practices such as fishing, farming, writing, painting (Peters, 2015).

In the context of research, one can also consider the many ways in which technically mediated practices can be involved in inquiry, from the ways in which engineers shape algorithms involved in online platforms from which data can be gathered for research (e.g. through APIs), to research software development, to the use of spreadsheets, word processors, operating systems, cloud services, app ecosystems and more (see e.g. Dieter, 2014; Gebru et al., 2021; Munk et al., 2020). Special issue contributors discuss and offer approaches to critically reappropriating online devices and digital infrastructures as the 'methods of the media' (Rogers, 2013; Weltevrede, 2016); cf. Ogden et al. (2023), Rieder et al. (2022), and Chao et al. (forthcoming) in this special issue), in order to access and assess their 'cascades of inscriptions' (Ruppert et al., 2013), creating awareness for their workings, their glitches, and flaws. This can be done through active and deliberate application of the underlying technologies and infrastructures, including AI and specifically ML techniques (Chávez Heras (2023) and Sánchez Querubín and Niederer (2022) in this issue) as well as through computational tool(-)making (Chao et al. (forthcoming) and Rieder et al. (2022) in this issue).

What is practice?

What is practice? What counts as a practice? How are practices shared? How may we attend to how practices deviate from the scripts of technologies and associated formats? (Re-)connecting Agre's understanding of CTP explicitly to an ethnomethodological understanding of the notion of practice (cf. Suchman, 2007: 14), we are interested in the *mundane methods* and *situated epistemic practices* of diverse practitioners. Media, technologies, and data – including the (research) devices to approach them as sites and infrastructures of study – are shared 'practical accomplishments' that are the product of collaborative material-discursive practices and the social conventions that informed these practices (Garfinkel, 1967 in Burkhardt et al., 2022: 11).

The ethnomethodological lens invites us explicitly to explore *on the ground* and *in action* similarities, interconnections, overlap, differences, and tensions between our own *critical technical practices* (as scholarly practitioners) and those of other professionals and involved actors. Contributions in this special issue, show that accessing – the traces of such – 'ethnomethods' in relation to computational infrastructures or algorithmic techniques asks for methods that actively intervene in and possibly also transform the field or site of study to a certain extent, turning to 'inventive methods' (Lury and Wakeford, 2012) and 'eliciting methods' to render accessible, follow and stage a form of performative and reflective engagement with specific technical practices (cf. Hirsbrunner et al. (2022),

Jacomy and Munk (2022), John-Mathews et al. (2023), and Madsen (2023) in this issue). Due to the entanglement of mundane, professional and research practices with distributed technological infrastructures, such practices are always also *multiply situated* (cf. Dieter, 2014) and ask for *cross-situational* perspectives (Burkhardt et al., 2022).

Relevant in our understanding of *practising critique* then is an explicit connection to the notion of *care* and the *caring for* all involved actors and material-discursive entities, the perspectives and values they represent (e.g. De la Bellacasa, 2017; Mol, 2008). Especially in interdisciplinary teams – prominent in today's digital media landscapes – taking all disciplinary inputs and needs evenly seriously can be a challenge (cf. Hirsbrunner et al., 2022). This special issue invites more work that explores what it means to – building on Annemarie Mol (2008) – collaboratively *tinker with* technologies in order to question their 'ontological politics' and write about this form of labour and interaction with other scholars and practitioners, and – highly complex – computational 'knowledge infrastructures' (cf. Ogden et al., 2023).

The importance of and how to *care for* the media technologies we engage with, (re)appropriate, or create, is discussed in relation to the challenges of interdisciplinary and cooperative method and tool design, including their documentation and curation (e.g. Hirsbrunner et al., 2022; Pawlicka-Deger, 2022, and Rieder et al., 2022). It implies collective responsibilities and ongoing reflexive exchanges between those who build and those who use digital methods and tools.

How is reflexivity?

In Agre's proposal of CTP as a deliberate and ongoing attitude that accompanies practical, technical work, he explicitly calls for, 'critical reflection upon the *reductio ad absurdum* of conventional methods. Ideally this reflexive work will make previously unreflected aspects of the practices visible, thus raising the question of what alternatives might be available' (1997b: 105).

In pointing out 'why [to] build things', Agre (1997a: 10) connects his work to Donald Schön's (1983) prior conceptualisation of the 'reflective practitioner' and his account of how practitioners reflect their working practices in action, including communicative action. Agre states that '[e]ach discipline's practitioners carry on what Schön would call 'reflective conversations' with their customary materials, and all of their professional interactions with one another presuppose this shared background of sustained practical engagement with a more or less standard set of tools, sites, and hassles' (Ibid. in reference to Schön, 1983: 78).

Schön's ideas on reflection later found resonance in the digital humanities. Writing about digital tool criticism, Koolen et al. (2018) take up his notion of 'reflection-in-action' to argue that reflection needs to be an integrative practice in research that explores the impact of tools on the epistemic process. Similarly, the work of van Es et al. (2021) on tool criticism adjoined by calls for critical reflection on tools and methods in computational research, indirectly engaged with Agre and Schön by way of Rieder and Röhle (2017).

While such a reflection-in-action approach builds on an understanding of reflexivity as a conscious activity and critical scholarly attitude, we find it important to connect this understanding of methodological reflexivity to an ethnomethodological conception of reflexivity (cf. Lynch, 2000). In this conception, all interactions between actors, their 'accounting practices' (Garfinkel, 1967:1) are *reflexive*, that is, leave particular material-discursive traces. Such an understanding of reflexivity leaves aside reflexivity's connotation as supporting a superior position of the distantly critical subject (Lynch, 2000), but supports an involved, plural critical practice, actively searching for exchange with others and their diverse viewpoints, including perspectives which have been marginalised. This notion of reflexivity also reminds us that our perspective as scholarly – or other – practitioners is always a partial

one, from a position *from within* and actively co-constructing the sites and objects of study, asking us to account for these (inter)relations (cf. Barad, 2007; Haraway, 1997).

What is needed is active access to, understanding of and (writing) formats to document and reflect on one's work with and on digital technologies, infrastructures, devices and tools (e.g., programming, data extraction, building of research applications/instruments). While computational methods and research software leave certain traces of their functioning (e.g. in log files), describing and offering them as *reflexive tools*, relating to both meanings of the term, requires diverse resources and understandings of their (future) communities of practice (cf. van Geenen, 2020; also Chao et al. (forthcoming) in this issue). This form of invisible research and development work requires institutional support, in terms of (digital) infrastructure, financing and paid working time, as Rieder et al. (2022) aptly note in this issue.

To be continued…

The above considerations are intended as reminders to reflect on what a critical technical practice is, who and what it may involve, and what it may invite. We hope they may contribute to ongoing work to pluralise CTPs in relation to the manifold societal and ecological crises that we face. Gathering and learning from work that engages with the notion remains an ongoing endeavour. To support this, we end this introduction by raising the prospects of a collaborative collection of publications, projects, and practices which self-describe as CTPs in the service of pluralising, diversifying and/or 'queering' (cf. Soon and Cox, 2020) what we think of when we think of CTP, and what it might be important to consider and account for when drawing upon the concept.[6]

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Notes

1. Disciplines in which in some fields publishing in books may be more common than publishing in articles.
2. For elaborate work on critical theory and critical design see, for example, Bardzell et al. (2012) and Bardzell and Bardzell (2013).
3. Within the strand of 'critical making', practitioners produced not just writings, but also practical resources, as illustrated by the 'Critical Making' book project by Garnet Hertz: http://www.conceptlab.com/criticalmaking/. For example, see also the resources and reading list initiated by Laura Forlano and contributed to by many others, some of which are also featured in this introduction: https://docs.google.com/document/d/1hmcbbUo74XzukRlQYvyHBytaN7MgDytgwzUhskzJ8Wg/edit?usp=sharing.

4. See, for instance, MIT Technology Review's coverage and discussion of the matter: https://www.technologyreview.com/2020/12/04/1013294/google-ai-ethics-research-paper-forced-out-timnit-gebru/.
5. The article 'Feasibility documents as critical structuring objects' was accepted and planned as part of this special issue, but inadvertently published by Sage in another issue.
6. To this end, we have begun gathering publications, links and resources from the process of editing this special issue, and welcome suggestions for things to add. Further details and links can be found at: https://publicdatalab.org/projects/pluralising-critical-technical-practices/.

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