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ARTICLE

AI 'Everywhere and Nowhere': Addressing the AI Intelligibility Problem in Public Service Journalism

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ABSTRACT

Growing prevalence of algorithmic systems and artificial intelligence in news production has prompted concerns over journalists' ability to understand and engage with them in ways that do not compromise journalistic norms and values. This 'intelligibility' issue is particularly acute for public service media due to the risks such complex and opaque systems pose for disrupting accountability, decision-making, and professional judgment. This article draws from document analysis and interviews with fourteen journalists to outline where AI is deployed in BBC news production and analyse how journalists make sense of AI and algorithms. We find a disconnect between increasingly pervasive AI and the level of understanding amongst BBC journalists, who are using guesswork and imagination in place of accurate conceptions of these technologies. This could limit journalists' ability to effectively and responsibly use AI systems, to question their outputs and role in news production, or to adapt and shape them – and could also hinder responsible reporting on how AI impacts society. We recommend PSM develop strategies for fostering AI intelligibility and literacy on three levels: individual, organisational, and community, and we reframe the AI intelligibility problem in sociocultural rather than solely technical terms in order to better address normative considerations.

KEYWORDS

Algorithms; artificial intelligence (AI); machine learning (ML); journalism; news production; public service media (PSM); BBC; intelligibility

Introduction

Is it important that journalists understand Artificial Intelligence (AI) and algorithms and if so, what do they need to know? This has become an urgent question given the increasing application of algorithmic and AI-based systems and techniques in news production and the growing importance of such platforms as intermediaries between journalists and their audiences and sources. The opacity and 'black box' nature of many of these technologies has prompted widespread concern about their impact when applied in a wide range of social settings, from the justice system to

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transportation and online communication (Pasquale 2015). In response, computer scientists, ethicists, social scientists, and policy makers are exploring how to make algorithmic systems intelligible, i.e. able to be meaningfully understood, in part to ensure transparency, fairness and accountability[1]. These are important values to journalism, which relies on demonstrating accuracy, impartiality, and objectivity to garner trust from audiences and uphold legitimacy in society.

The question of what it means for AI and algorithms to be intelligible in the journalistic context is however yet to be fully addressed. A significant body of research suggests these technologies are changing journalistic practices and processes and reshaping what it means to make and consume news (Diakopoulos 2019, Marconi 2020, Beckett 2019). Studies have explored the operation and impact of platform power (Gillespie 2018, Helberger 2020, Poell, Nieborg, and Duffy 2022; Van Dijck, Poell, and de Waal 2018, Whittaker 2019), audience news habits and attitudes in an algorithmic news ecosystem (Fletcher and Nielsen 2019, Toff and Kleis Nielsen 2018, Ytre-Arne and Moe 2021) as well as responses to automated news (Wölker and Powell 2021, Graefe et al. 2018, Jung et al. 2017, Clerwall 2014), and the ethical and ontological implications of AI in the newsroom (Porlezza and Ferri 2022, Gunkel 2018). However, we know little about how journalists make sense of AI and algorithms in their work despite the importance this holds for how news and journalistic knowledge is produced and thus how meaning is made and communicated in such a socially significant arena. If we recognise the role that ideas, and the communication of ideas, play in shaping what is possible and what is deemed desirable or acceptable amongst communities, then journalists' algorithmic imaginary - their "ways of thinking about what algorithms are, what they should be and how they function" (Bucher 2017a: 30) - becomes a primary object of sociological and cultural investigation.

AI is a fundamental component of many of the data-intensive technologies already familiar to journalists, which have engendered new modes of news production, consumption, and distribution (Zamith 2020). For example, application of AI techniques underpin the methods used by social media to filter, curate and amplify information, which has led to new sourcing, verification and distribution practices (Lewis and Molyneux 2018). It also enables data-mining and analytics tools to classify and interpret large and complex data sets, which allow journalists to analyse source material at previously unattainable scale (Stray 2020), particularly for investigative reporting (Broussard 2014, Stray 2019) and open-source intelligence (OSINT) investigations (Ganguly 2022). Changes induced by these and other applications of AI include: altered routines such as 'social listening' and the packaging of metrics that shapes coverage priorities (Burgess and Hurcombe 2019) leading to forms of "institutional isomorphism" (Caplan and Boyd 2018); novel practices such as overseeing automated story-writing (Carlson 2015, BBC News Labs n.d); and new roles such as "intrapreneurs" (Belair-Gagnon, Lewis, and Agur 2020), and "bot producers" (Jones and Jones 2019). It is crucial to understand that AI-driven tools represent new actors that intermediate and influence how journalists operate (Wu, Tandoc, and Salmon 2019). This requires new modes of theorising and conceptualising their expanded role, for example as communicators - a challenge the emerging field of Human-Machine Communication (HMC), is focusing on through the study of the "creation of meaning among humans and machines" (Guzman and Lewis 2020).

This growing prevalence of complex algorithmic and machine learning (ML) systems in news production has prompted concerns over the ability of newsworkers and their organisations to understand these systems and engage with them in ways that do not compromise journalistic norms and values. Many of these systems are designed not only to automate simple and repetitive tasks but are increasingly vehicles for delegated decision-making and judgment, thus distributing control and influence between journalist and machine. The gathering pace at which AI and algorithms are being applied to news production tasks - at least in large organisations in developed nations - suggests we are in a crucial period of flux in which understandings, meanings and roles of these technologies have not yet stabilised. The various stages of development, introduction, adoption and adaptation of novel techniques and technologies present opportunities to stimulate discussion of what journalism *is/does* and *should be/do* in concert with debate about what specific technologies *are/do* and *should be/do* in a democratic context.

Public service media (PSM) have a particular stake in answering these normative questions in ways that align with their specific role and remit, and meet legal and regulatory requirements as well as public expectations. A number of PSM have recently made the question of how AI can be used to support their goals a central concern (European Broadcasting Union (EBU) 2019; 2020, Caswell 2020) while at the same time the European Commission has proposed draft AI regulation stipulating rules for high-risk applications (European Commission (EC) 2021). Scholars have similarly explored how algorithmic systems such as news recommenders might be designed to advance values and goals considered essential in a democratic society (Helberger 2019). However, the task of bringing high-level, theoretically informed ideas into dialogue with the practical activities of computational system design remains a challenging one, well recognised in computer science, human computer interaction (HCI), and wider design literatures but less thoroughly explored in journalism studies. This work involves eliciting values, surfacing normative assumptions, determining agreed aims and goals, and identifying (un)intended consequences. These tasks become more complex when the systems in question are a) designed to distribute control between humans and software that "learns" patterns from data, and b) often invisible and opaque to users, and at times unintelligible even to experts.

So why should journalists care about these transformations going on behind the interface and beyond the newsroom? And what makes AI different to any other technologies journalists use without understanding how they work? In short, it is the heightened risk of harm and detriment. These technologies are being delegated tasks that are fundamental to knowledge production and have previously been the preserve of journalists, including decision-making, interpretation, and exercising judgment. The information applications of AI can generate must be appropriately evaluated and weighed, and the types of evidence they construct (predictions, relationships etc.,) need to be incorporated into journalists' epistemological practices of seeking truth in order to adequately justify claims about the world (Diakopoulos 2019). In this context, poor AI literacy poses distinct and cumulative risks:

a. *At the individual level* - to the journalist, who through lack of appropriate understanding risks misinforming audiences but also as a user of AI software, risks

either over-reliance and misplaced trust in the accuracy and ability of so-called intelligent systems ('automation bias'), or conversely risks missing opportunities to reap benefits through fear, under-confidence, and ensuing under-use ('algorithmic aversion');

b. *At the organisational level* – to news providers, which then risk introducing uncorrected errors, unrecognised biases, and being unable to sufficiently account for and justify editorial decisions, which in turn could harm professional reputation and undermine the legitimacy of journalism in society;

c. *At the community level* – to journalists as a collective group with a collective voice, which risks ceding power in the conversation about, and the material re-shaping of, the profession. This could occur as the community struggles to find ways to articulate common values, commitments and obligations in relation to algorithmic systems, instantiate them through those systems, and exert agency in relation to those systems in practice.

As it stands, technology platforms, corporations and advertisers are dominant in framing AI and creating the conditions in which media practitioners work (Brake 2017, Whittaker 2019, Simon 2022). We argue there is a clear and pressing need for journalists to contribute their voices to inform and influence the AI agenda - particularly in their own newsrooms - and that this effort needs structural support to make AI intelligible.

This article contributes to the critical discussion of automation, algorithms, and AI in the news media and public service institutions as well as advancing understanding of an important and often overlooked 'user' community - journalists. By focusing on the UK's largest public service broadcaster, the BBC, as a case study, the research counters the propensity of much current discussion of AI in news to generalise across contexts. We combined document analysis and interviews with journalists to scope the intersection of AI and news at the BBC and discuss how BBC journalists understand AI-driven and algorithmic systems.

AI and Algorithms in Journalism

It is important when discussing AI to address the fundamental issues with defining the term. Definitions of AI abound and use of the term ranges from describing speculative notions of sentient machines to routine applications of maths, statistics, and data analysis. As Broussard et al. highlighted, the descriptor AI is "polysemous and problematic" and "tends to be invoked broadly and haphazardly" (Broussard et al. 2019: 673) with allusions to the depictions common in science fiction and Hollywood. To complicate this further, what is considered to be AI is a moving target in that "once a particular problem is considered solved, it often is no longer considered AI" (Kaplan 2016: 37).

In order to understand the role of AI in journalism then, it is clear we must take seriously not only the technical features of the systems broadly understood to fall under this rubric, but also stories that are told about what AI *is* and *does*, and what it *should be and do*. This involves identifying dominant narratives amongst relevant communities such as journalists - but also developers, and managers within news

organisations, and those beyond their borders such as technology companies, politicians, civic society organisations and audiences. It also involves interrogating how these narratives can be manipulated and mobilised by stakeholders in efforts to determine how this genre of technology is perceived and what reactions it provokes. Exaggerated expectations and fears about AI and an over-emphasis on humanoid representations that are common narratives in society may affect public confidence and perceptions and contribute to misinformed debate, with potentially significant consequences (Cave et al. 2018). Narratives such as these shape the possibilities for action and interaction; they are performative and contribute to *enacting* AI.

When we refer to AI in this article, we are identifying what is called 'narrow AI', which denotes the engineering of computational systems to perform specific tasks like playing chess or translating languages - a field that has in recent years been propelled by advances in machine learning (ML). These are data-intensive human-programmed software systems that learn patterns from data. This is far from the depictions of artificial general intelligence (AGI) we see in popular culture represented as seemingly conscious or sentient systems or robots. AI has found numerous applications across the entire news production process from gathering to producing and distributing news as well as marketing and interacting with audiences. Some of these applications automate individual tasks, others entire processes or workflows (Diakopoulos 2019). For instance, automated news production (Carlson 2015) uses natural language generation (NLG) and processing (NLP) to perform the end-to-end workflow of algorithmically converting structured data into stories in text, video and audio form (Caswell and Dörr 2019, Dörr 2016, Lindén et al. 2019). At the other end of the scale, data-mining techniques assist with specific document analysis tasks (Stray 2020), particularly for investigative reporting (Broussard 2014, Stray 2019) and news discovery aids perform specific monitoring and alert functions on data at scale by combining numerous source inputs (search engines, social media etc.) (Diakopoulos 2020). The curation and recommendation of news for audiences is also increasingly automated by segmenting and profiling them to determine user preferences (Helberger 2019). News organisations are also grappling with serving news via voice agents that have become embedded in mobile phones and in homes (Turow 2021) and are deploying AI for non-editorial tasks such as marketing and paywall optimisation (Jamil 2021) as well as tackling bias (Peretti 2020; 2021). Meanwhile big technology companies are increasingly serving the journalism market with tools, training, and research and development funds (e.g. Google News Initiative and Facebook Journalism Project), extending their well-documented influence in the journalistic field (Simon 2022, Tandoc and Maitra 2018). AI underpins these tools but journalists do not often "use AI" in the sense of applying/deploying it (except for a tiny elite of journalist-developers who create ML models), rather they use outputs of software and systems that incorporate AI - relying on decisions they make, which are communicated via user-facing dashboards and interfaces.

Integration of AI has however been unequally distributed across the news industry and remains in early or experimental stages in most organisations (International Centre for Journalists (ICFJ)) 2019), in many developing nations (Jamil 2021; 2021), and in local newsrooms, limited in part by a lack of know-how and market constraints (Wilczek et al. 2021). In-house AI development and large-scale procurement and

maintenance remains a reality for only the best-resourced and elite news organisations, leaving small, community, and local newsrooms at a disadvantage. However, increased commercialisation of AI-driven tools for "off-the-shelf" use in journalism - for example those exploiting natural language models like Open AI's GPT-3 for transcription, translation, or text generation – have recently provided lower-cost entry into the field. A global survey of mainly technologically expert staff within news organisations in 2019 found that AI was "additional, supplementary and catalytic, not yet transformational" (Beckett 2019: 6). Whether it ever becomes transformational in news production (and indeed what such transformation might consist of) is an open question. The hyperbole around AI remains widespread and is often accompanied by a deterministic narrative of inevitability, advanced in particular by those big tech companies likely to gain from such rhetoric. However, increasingly sophisticated and nuanced understandings have begun to counter such accounts in relation to journalism, supported by evidence of actual applications and limitations (Diakopoulos 2019) and use beyond the US and European context (e.g. Munoriyarwa, Chiumbu, and Motsaathebe 2021, Kothari and Cruikshank 2022).

The important point to make here is that AI systems represent a step change in complexity and opacity compared to prior computational systems that have been deployed in journalism. First, this is because of how they are designed to "learn" by discovering patterns in large amounts of data and create predictive models from that data. This makes it difficult for people to understand precisely how and why an algorithmic outcome was obtained – including at times those creating the system (e.g. deep neural networks). Second, this is because they are often proprietary systems protected from public inspection, e.g. by trade secrecy. Third, this is exacerbated by shortcomings of prevailing approaches to scrutinising such systems (Kroll 2018). These factors lead to a far greater inability for both experts and non-experts such as journalists to scrutinise their processes, assess their suitability for the tasks for which they are used, hold their decision-making accountable, and form the necessary robust justifications for how and why their outputs are used in news production. Taking social media as an example, something as seemingly small as a tweak to a machine learning algorithm can undermine news organisations' distribution strategies and force industry-wide adaptation as happened in 2014 with native video on Facebook (Tandoc and Maitra 2018). Meanwhile, journalists now see and respond to "algorithmic publics" (Christin 2020) constructed through aggregates of data filtered by AI in analytics systems and on social media feeds, often with little understanding of, or ability to alter these partial representations the world.

Moreover, as AI and algorithmic systems have become more prevalent in everyday life, journalists must increasingly report on the growing influence they have in society – a challenging task given low levels of practitioner understanding of AI, coupled with lack of transparency from commercial providers and their extensive public relations efforts. This even impacts coverage of their own industry, where narratives contrast between 'hopeful' newsroom leaders and funders and 'concerned' journalists) (Moran and Shaikh 2022). It has so far mainly resulted in relatively uncritical industry-led coverage (Brennen, Howard, and Nielsen 2018) and "shallow" engagement with AI ethics (Ouchchy, Coin, and Dubljević 2020) except for a limited number of specialist

outlets (e.g. The Markup and ProPublica in the US) and projects focused on algorithmic accountability reporting (Diakopoulos 2015). This risks misleading and misinforming publics about both the potential and limitations of AI (Kapoor and Narayanan 2022).

The Importance of Making AI Intelligible

Journalists need to take informed and accountable actions even as a broad suite of data-driven digital technologies, including AI, are delegated previously manual responsibilities and decision-making capacities. These technologies may prioritise alternative values, purposes, and interests as a result of the contexts in which they were engineered - such as making clicks the primary indicator of success, prioritising data collection over privacy, or scale and efficiency over context and depth. In this context, important discussions need to be had about the kind of values and purposes journalists want AI and emerging technologies to support and how socio-technical systems might be designed to reflect them (Gutierrez Lopez et al. 2022). There has however been comparatively little research into AI in the public service media context and a lack of exploration into the core community of 'users' of AI in this context - journalists. This leaves a gap in our understanding of how the practitioners at the core of news creation actually encounter, perceive, understand, and feel about AI.

Making AI intelligible has become a primary concern for researchers who have built an entire field of inquiry into how to design systems able to explain their autonomous decisions and actions to human users (explainable AI (XAI) and interpretable ML (iML)) in order to improve trust, understanding, and effective use/management. A branch of this endeavour focuses on the human factors at play and explores human-computer interaction (HCI) to identify individuals' needs and strategies for understanding (Miller 2019, Mueller et al. 2019). However this work is primarily focused on technical solutions, which are just one part of the intelligibility puzzle, and is usually not socially situated despite the importance of context for meaning-making and understanding. AI in journalism is always embedded in organisational, professional, and socio-cultural contexts. This matters for how we approach what it means to make AI intelligible. It is not at all clear yet whether systems using AI in news production will need to be explainable or what journalists will need to know to engage responsibly with them.

A first step towards answering these questions involves finding out what journalists currently know and how they make sense of AI and algorithms, which can impact editorial practices including gatekeeping and news selection (Peterson-Salahuddin & Diakopoulos 2020). This opens the way for consideration of what types of responses aimed at journalists could promote informed and responsible practice. For instance, fostering a broader understanding and critical literacy amongst user communities may be just as important as designing explainable systems, and creating robust socio-technical infrastructures to support responsible use of, and reporting on AI may be needed. Bucher contends that examining how algorithms make people feel will be crucial if we want to understand their social power and suggests that what she calls the "algorithmic imaginary – ways of thinking about what algorithms are, what they

should be and how they function" can play a generative role in moulding algorithms (Bucher 2017a: 30).

Research Approach

Our two interrelated propositions are that: 1. AI is being increasingly used in news production at large organisations, including PSM like the BBC; 2. there is a lack of intelligibility among members of the journalistic community on the ground who increasingly rely on these technologies. We seek to investigate if this is the case, what the important factors and dynamics are, and what challenges this presents for (PSM) journalism.

This study addresses the following two research questions:

RQ1: How is the BBC using AI in news production?

RQ2: What are BBC journalists' experiences with, understandings of, and attitudes towards AI and algorithms in journalism?

We begin from a sociotechnical approach which acknowledges that the production of news is accomplished via the (inter-)activity of heterogeneous assemblages of social actors and technical artefacts. This encompasses people and the narratives they espouse, hardware and software, workflows and routines, rules, norms and practices - what Lewis and Westlund (2015) encapsulate as a matrix of "4 A's" - actors, actants, audiences and activities.

With this in mind, using qualitative case study research that draws on abductive enquiry and inductive techniques of analysis (Eisenhardt 1989) we first outline where news production and AI technologies intersect in the infrastructures that underpin BBC journalism. As AI becomes more pervasive and ubiquitous across media sectors, it can appear impossible or futile to keep abreast of where, when, and how it is applied. However, identifying and describing AI in situ is vital groundwork necessary for then analysing and understanding its implications for the media industry, journalistic practice, and democratic society. Crucially here, it is a central precursor to establishing well-informed normative and value-driven approaches to managing and directing AI, which will be the lynchpin of ensuring AI works in service of the journalism to which public service media aspire.

We then focus on how the meaning of AI and algorithms is discursively constructed by BBC journalists by interrogating how they articulate their understandings, experiences, perceptions and attitudes. We then discuss the implications of these findings for the BBC and other PSM as well as the wider journalism industry and derive from these insights a set of recommendations for fostering intelligibility.

Data Collection and Analysis

To answer RQ1, we first conducted document analysis to identify applications of AI in news-related activity at the BBC, including in-house research and development projects and the use of externally procured technologies and services. For this, we analysed records of AI and ML activities, first by assessing all entries to an internal resource - the *pan-BBC AI/ML Initiatives Register* - which gathers together research,

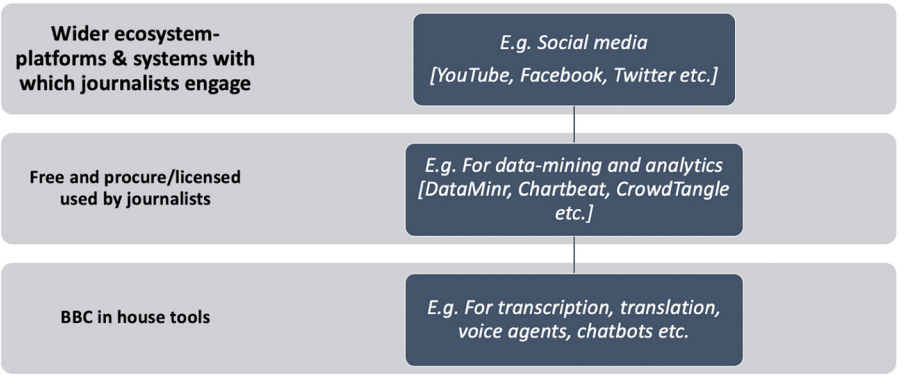

Figure 1. Categorisation of journalists' use of AI tools at the BBC.

development, and deployment related to AI and ML by crowdsourcing details from individuals and teams across the organisation. As there was no guarantee the register reflected all the pertinent activity we sought, we supplemented this with a variety of other sources, including blog posts and public-facing communication (e.g. project updates from BBC News Labs and R&D), and internal technical notes. We then cross-checked and contextualised this information by conducting informal conversations with teams across the BBC including its journalism innovation unit News Labs and R&D in order to identify gaps and validate the accuracy of our analysis. We distilled this data into a list of relevant technologies and systems and categorised them according to the following criteria:

1. In-house (BBC developed)/third party/collaboration
2. In development/testing/in use
3. Widespread use/targeted use
4. Audience-facing/practitioner-facing/combination

Using this classification, we constructed a tripartite structure for conceptualising journalists' encounters with AI-driven systems, depicted in Figure 1.

We then conducted in-depth semi-structured interviews with 14 BBC journalists and editors about their experiences with, understandings of, and attitudes towards AI and algorithmic systems. The insights from our review of literature and output of our AI scoping exercise were used to tailor a number of questions in each interview to the context in which the interviewee worked and the AI and algorithmic systems with which they were likely to come into contact. The sample of interviewees was drawn from local BBC newsrooms in England and consisted of editors (2), journalists (4) and senior journalists (8) who worked across online (8), radio (2), television (3) and a news innovation unit (1). The interviews lasted between 30 min and one hour each. The aim here was not to be representative in a statistical sense but rather to elicit rich qualitative detail to represent common perspectives and narratives and better understand how and why these were formed by journalists. The findings are not generalisable beyond the context but provide insights that could be pertinent for similar contexts and illuminate elements for exploration across different circumstances.

The interviews were transcribed and pseudonymised then coded independently by two of the authors in a process of independent parallel coding, often used in a general inductive approach (Thomas 2006). Two coders independently analysed the transcripts and each developed a set of categories, which they annotated with explanations of why each individual category was devised, and then compared the two sets in order to establish the extent of overlap. The coders then merged these into a combined set and further analysed and discussed the categories to develop summary themes. Though we deployed what are traditionally considered explorative inductive techniques of developing codes from the empirical data, our approach stems from an abductive logic of research that is geared to the question of theoretical relevance and is explicitly about connecting observations with existing bodies of theory (Tavory and Timmermans 2020). With this approach, we aim to move from an inductive question of 'What is Going on Here?' (that underpins grounded theory as per Glaser and Strauss 1967) to 'What is this a Case of?' (Timmermans and Tavory 2012). We thus acknowledged some basic assumptions derived from theoretical work and moved back and forth between the interview data and theory in order to characterise common understandings, experiences, beliefs, concerns and attitudes in respect of AI.

Hidden and Pervasive AI in Journalism at the BBC (RQ1)

We propose a three-level structure to the way AI intersects with news production at the BBC (see Figure 1):

1. Journalists use a wide array of external platforms/services/systems/tools which have significant AI components - such as social media and open source intelligence tools - and this is where they most regularly encounter AI.
2. Journalists also use a smaller set of specifically procured/licensed/subscription/free tools that employ AI, such as Dataminr for identifying leads, Chartbeat for running analytics, and CrowdTangle for monitoring competitors and trends.
3. A much smaller suite of AI-driven tools is being developed in-house or in partnership with others, some of which are used by journalists day-to-day but many of which are still in the development stage (see Table 1).

Much of the development and application of AI for news (see Table 1) has taken place within BBC News Labs, an innovation-focused unit founded in 2012, combining technical and editorial staff to experiment with news products and services and prototype proof-of-concept systems that may transfer into day-to-day news operations. News Labs is what Belair-Gagnon, Lewis and Agur describe as an "intrapreneurial unit" which tends to "adopt a logic of experimentation, audience orientation, and efficiency-seeking" (2020: 291). News Labs rarely build their own ML models, rather there are various mechanisms for obtaining components built externally, for example, using or connecting to models, licensing them, or partnering with others to collaboratively build them. Addressing the difficulty of keeping tabs on applications of AI in organisational settings, the unit's head of product development described the idea of recording all ML applications as "perhaps a bit like keeping a log of applications of

Table 1. Illustrative examples of BBC-produced AI-driven systems.

Example BBC system & Journalistic Use(s)	AI technique(s)
Kaldi: speech-to-text engine	Transcription using NLP, speech-to-text
Audiogram Generator: audio visualisation tool (powered by Kaldi)	Transcription using NLP, speech-to-text
ALTO: virtual voice-over tool for reversioning video content into multiple languages	Machine translation, speech-to-text auto subtitling & text-to-speech, voice synthesis (synthetic speech)
BBC digital voice assistant (Beeb): voice agent	NLP, NLU, NLG, speech-to-text, text-to-speech
Climate bot: chatbot	NLP, machine learning
Factorisation engine: news recommender system	Content-based and collaborative filtering using machine learning
OCTO: media editing, repurposing and augmentation for automated content production	Automatic speech recognition, shot detection
In-app personalisation: segmenting audiences and curating content	Unsupervised machine learning
Discoverability scoring: identifying ease with which audiences could find content	Machine learning (graph-based)
Subtopic generation: automatically creating subtopics for major topics in online news content	Machine learning

electricity in about 1925". This suggests ML is proliferating and playing an increasingly infrastructural role.

We found that the pervasive and hidden nature of AI within workflows, pipelines, and systems makes auditing its existence and extent a notable challenge. The significance of this is the barrier it raises for researchers, organisations, and regulators in their ability to 1. monitor the full scope of where AI is "acting" in the broader technology "estate" of media and news organisations and 2. identify the loci of responsibility in each case and how this effects their ability to understand how AI decisions are taking effect – particularly how multiple applications might interact to generate higher level system effects. Without this information, auditing deployed AI systems in terms of how they are performing particular tasks is an extremely difficult endeavour. The core challenge arises from the previously discussed ambiguity about what AI is, which impacts the types of techniques and technologies that are identified and logged by an organisation as AI and recognised by external actors, including researchers, as such. If an ML model is applied in one small element of a larger system (as is often the case), does this get classified as AI? Do different teams define AI in the same way? This suggests a need for both technical and social methods of tracking AI in news organisations and when necessary, communicating its role to practitioners.

AI Everywhere and Nowhere: A Journalist's Eye View (RQ2)

It is important to begin by noting that ten of the fourteen interviewees were reticent to be interviewed on the topic of AI and algorithms, and six others chose not to be interviewed. Thirteen interviewees described feeling unknowledgeable and under-confident and therefore poorly prepared to speak about the topic, stating they would "have nothing to say". For example, after a few minutes talking, Lizzie suggested:

> Once I've had a little google of what an algorithm is, do you want to bring me back so I don't look like a complete idiot! [laughs]. (Lizzie, online)

This is not a trivial observation as it suggests an 'othering' of these technologies by journalists as not within their realm of expertise and interest, and could present a

barrier to engaging journalists on a topic of such import for the future of their jobs and profession. For instance, Orla illustrated how the act of reflecting on knowledge and understanding of these technologies was uncommon:

> I guarantee you I've never spent a minute thinking about all those technologies you mentioned coming in my job. You just do your job and you're happy with how it works, I know it all works in the background, and you don't know it's there, like Chartbeat. I get that it's all technology, but I just don't care basically if it works, it does its job and I don't really care how it does it, why does it, I just know how I use it and how it works. Just a very functional way of doing work and not having time to think about it more than anything else. (Orla, television)

This could appear to suggest a general lack of awareness but there was variance in levels of understanding amongst the cohort and though we have derived common themes from the data below, it should be noted that journalists held a mix of sometimes overlapping, contrasting and unsettled views on AI and algorithms.

Guesswork and Imagination

Eleven of the interviewees found it difficult to discuss AI and algorithms in the abstract (i.e. not related to any specific technology/technologies) and struggled to differentiate between AI, algorithms, and automation, often using the terms interchangeably. For example, Emilia found AI difficult to describe:

> I suppose artificial intelligence, I kind of, just presumed that it would be … erm … computers doing searches and finding things out … erm. It might be the computers are just set up to find particular things. And then you ask them a question … I don't know, I'm not really sure, to be honest." (Emilia, online)

And when asked if there was a difference between AI and algorithms, Alex was unsure and did what ten other interviewees did - took a guess:

> I mean an algorithm would be that like a human had to create it … Don't you have to create the algorithm then for it to run? … I guess [for AI] the computer is the brain. The computer makes decisions, that would be my guess. (Alex, online)

This illustrates the first main theme of the interviews - guesswork and imagination - which describes how journalists speculated on the existence, location, and role of AI and algorithms in journalism and in the wider world. For eleven of the fourteen interviewees, the interview was the first time they had talked in depth on the subject of AI and algorithms in the context of their work. They described AI as "esoteric", "foreign", and "new" and engaged in a lot of guesswork and speculation, exemplified by regular use of the words: "imagine", "suppose", "presume", and "might" to describe what AI is and does. Connected to this was the overarching trend of seeing AI as both *everywhere and nowhere* simultaneously. What we mean here is a lack of awareness of AI in the technology being used for journalistic purposes, coupled with a suspicion that anything appearing to be automated was in fact AI. Take for example Martin, who self-identified as a "geek" and someone who experimented with new technologies in the newsroom. He was asked if any of his newsroom's technologies contained AI, he was very uncertain and seemed to change his opinion within the same response:

> Any AI systems … I'm thinking … Not that I'm aware of. You're going to tell me now that something I use every day is [laughs] …
>
> I know there is automation in a lot of things that I use, but I wouldn't necessarily class that as AI. Yes, the gallery is automated, a lot of the stuff when I'm on air, that's automated … I hadn't particularly classified that as AI, *but I suppose it is really* (emphasis added). (Martin, television & radio)

The aim here is not to pass judgment about how much journalists know about what we have already recognised to be an ill-defined and invisible set of technologies and techniques, but rather to point out that even the most tech-savvy journalists, remained very uncertain about where AI was pertinent and the impacts this might have. Talking about where AI might be in the newsroom, Kate explained:

> "but you don't know, there's not a massive badge on something that says, this has been created by AI. (Kate, radio)

When asked if AI and algorithms affect his work, Alex was unsure and moved instead to imagine the impact to the audience:

> I don't know how it would affect how I worked. I could tell you how it can affect the consumer. I can see how if someone's got the app … people follow tags at the moment, it's pretty basic. I get how it could affect that but I don't know how it could affect me working though. (Alex, online)

Lizzie provided an example of how repertoires of cultural resources including films and stories in newspapers and magazines were used to make sense of AI. She recognised the importance of film in shaping her idea of AI but was uncomfortable relaying what exactly this meant:

> I'm feeling, like, really foolish that I don't know … I feel like in my head, I know from what I've seen in films but I honestly just don't want to say [laughs]. That is honestly what my knowledge of it would be - from films. (Lizzie, online)

We found a link between journalists' *perception* of AI and their *conception(s)* of AI. Representations in the media (e.g. in news, popular culture, film) and their personal experiences as a consumer and at home (e.g. "my Alexa") shaped how they formed ideas about AI, imagined it, and developed an understanding of it. When they did not perceive AI as being in the newsroom, they did not readily conceive of it as relevant for journalism or their job. Fourteen interviewees reported that explicit discussion of AI and algorithms with colleagues was rare or non-existent. After describing what he thought AI was, Jonathan reflected:

> Having said all that out loud, I have no idea where I've got that from. I think it's from reading you know newspaper articles and that sort of thing … So it's really personal life. It's certainly not something that's ever been discussed in any newsroom that I've ever been. And it's never discussed: 'oh, should we be careful of the algorithms in this? Or have we ever thought that there's any AI involved in this?' Those things don't ever happen in a newsroom. (Jonathan, online)

Whereas Kate referred back to wider media coverage and how discussions took place in her personal life, rather than professional life:

> There probably has been discussion, if there have been sort of high-profile news reports about an algorithm that can write a sports report, a match report, for example, you know,

> I think people have talked about those kind of things. But not in not in any serious way. It's certainly just discussions that I've had in my wider life about computers. (Kate, radio)

However, issues related to the operation of such systems did implicitly arise when they stopped working as expected. If we understand these systems as performing an increasingly infrastructural role, this illustrates the tendency for infrastructure to disappear except when breaking down (Star and Bowker 2006, Star and Ruhleder 1996). Asked about when algorithmic technology gets talked about, Martin laughed:

> When it doesn't work! If it works, you deal with it and it's part of your day-to-day life and something else will come along and be automated or change and you deal with it. But when it falls down and it doesn't work and you're having to think of workarounds and interact with it to budge it. That's when it becomes part of the conversation. (Martin, television and radio)

This suggests AI and algorithms have become "sunk" into the news production assemblage but that points of friction and reflection occur when a blip in a system makes its existence and its components visible. Given interviewees' reported uncertainty about how algorithmic systems function and the opaque nature of many such systems, this prompts questions about how journalists would know if something was "not working" as it should, for example, if there was unwanted bias in an ML model's training data, or if algorithmic filtering was hiding or amplifying information in problematic ways.

Hopes, Fears and Judgments: The Normative Dimension

In contrast to popular portrayals of AI in the English-speaking West, which "tend to be either exaggeratedly optimistic about what the technology might achieve, or melodramatically pessimistic" (Cave et al. 2018), we found a more balanced account from our interviewees. None held fixed opinions about whether AI is/would be good for journalism and its role in democratic society. Rather they made contingent judgments positing that *if* a certain set of conditions were met, AI *could* be beneficial and *if* not, it *could* be harmful. When the idea of automated news writing was broached with Alex, he suggested his reaction would be dependent on his understanding of it and the quality of the output:

> I don't understand how that would work. I'd be interested. It sounds crazy and like it wouldn't work so journalists and other people are like 'it can't do that', that's too futuristic, too creepy. But if someone explained it to me and I thought it was good, I'd be receptive to it - but my instinct is the same as everyone else's: I don't get how that's possible. How do you get a press release from the police and put it through a computer and then it turns into what I would write or what you would write? I think you'd just get copy and paste surely, I don't think it would be journalism, but if someone could show me it in action and it wrote a story and I thought well that's a good story, I'd be perfectly happy with it. (Alex, online)

Discussing the idea of algorithmic recommendations for public service media, Lizzie made a similar point and applied her professional judgment of what would be appropriate or breach journalistic norms:

> Obviously there's always a caveat with these things but in principle, no, I don't have any major objections to it at all. But given the sensitive nature of some of the stories we

> cover, say for example there was a story about a multiple serial killer and then it just flagged up another story about a serial killer and the only relation is that there's been multiple deaths. You've got to kind of think of the sensitivities around that and if people will draw any inferences and links between them … I guess it just depends on how it's set up and what systems they used to generate which stories would be recommended. (Lizzie, online)

This illustrates how journalists applied their professional expertise to speculative scenarios to identify potential issues and express their anxieties. It also highlights the way they describe not being able to understand how algorithmic technologies perform what they see as journalistic tasks - and a desire to understand. For instance, Jonathan worried about the implications for bias and diversity of allowing algorithmic curation of the BBC website:

> I think if I'm honest, curation should always be an editorial process. It shouldn't be an automated one. I think if you move to an automated structure it takes away some for the purpose of news, you know, we are trying to drive a news agenda. We're trying to keep the news agenda fair and wide (Jonathan, online)

In these examples, we can also see judgments being made about what can be deemed 'good journalism'. In the first instance, this relates to the probing, creative and interpretive characteristics that go beyond "copy and paste", in the second, it is the understanding of cultural sensitivities whilst in the third, it is determining what is important to cover through gatekeeping and agenda-setting. Online editor Eric raised a pervasive underlying fear when he estimated that at least 70% of journalists "would probably think it [AI] is going to do us out of a job" and described the limitations of automated writing as he sees it:

> As a sub-editor your heart sings when you see a piece of beautifully written prose when the writer's obviously thought about it so that it has a nice flow, and a nice meter and nice alliteration and use of language, whereas you know a computer just can't do that as yet - and I hope it's 20 years until they can or we're out of a job.

Eric expressed fears found more widely in the general population that "this technology could replace me" (Cameron and Maguire 2017: 27) and the dichotomy of "ease versus obsolescence" (Cave and Dihal 2019: 76) whereby people dream of being free from work but are fearful of being put out of work. Sarah saw potential AI-related job losses as a broader trend in technological development:

> The fear then is that more automation, less people, less jobs (…) if the automation of a gallery means one person can hit a button and do the job of three. And that's really what technology has been about hasn't it, well a lot of it. Obviously you need the brains to develop it but you need less people to administer it. (Sarah, television)

It was a less common theme, but five journalists also discussed the aspirations they held for how AI should be used to improve journalism in ways currently beyond reach. Roberta for example talked about how for AI to be worthwhile, it should help engage diverse audiences, using machine "intelligence" to reduce inequalities in news access and engagement:

> For me it's about using technology for the benefit of people, for all walks of life and all ranges of people and all levels of interest. It's going "I can create an algorithm that goes 'right you live in the back end of Salford, are very poor, but I know I can give you access

> to this, that will open your world up' and in a tone where they go 'actually, I want to come back to that.' But then it's also going to the people who live in Chelsea who might think they're a bit snooty to go 'actually this is useful to me.' *You need it to be that intelligent that it takes away all the inequalities.* Whether that's achievable I don't know. (emphasis added) (Roberta, online)

Desire for Agency and to Learn More

The lack of visibility of AI in relation to news coupled with lack of discussion about AI and algorithms meant there had been little reflection of the role, impacts or implications for journalism. Thirteen interviewees expressed a desire to find out and learn more. Emilia said these topics had not been broached in her professional life:

> I'm not really worried about it at the moment but I think I should do more to find out what the risks could be. I would like to know more because I think it's really important, but it hasn't come up yet. (Emilia, online)

Jonathan suggested their needs may be less about functional 'how-to' training and instead more about discussion and critical engagement:

> I think it's less training, more discussion. I think we all kind of know the basics of, you know, what using social media is or using Dataminr and things like that. But I think it's more that discussion around what you're actually getting and what you're actually going to see and how you can change those parameters. That would be incredibly useful. (Jonathan, online)

Finally, Martin exemplified a desire to not only know more about these technologies but to have some agency and ability to feed into how they impact their work:

> I want to know how they work. I want to know who's programmed the software and who's told it what questions it is to look out for, or what the software is looking for, then I want to know how I can adapt that software so I get the results I need to find the truth about particular stories out and I want to make sure I'm being shown all the content and not filtered content. So I want to know how I can manipulate that technology so I know I'm getting both sides of the story. (Martin, television and radio)

Discussion and Recommendations

We set out to investigate two interrelated propositions: 1. AI is increasingly prevalent news production at large organisations, including PSM like the BBC; 2. There is a lack of intelligibility among the journalistic community on the ground who increasingly rely on these technologies. We found a growing application of AI in technologies which journalists encounter in their day-to-day work at the BBC (see Figure 1). However, we highlighted the complicated and hidden nature of AI within workflows, pipelines, and systems and discussed the implications of this in terms of understanding and auditing the existence and impacts of forms of AI on journalism. We found a disconnect between this shift in news production technologies and the levels of understanding of these systems in this community of journalists. We posit that this intelligibility issue could negatively impact journalists in three broad ways by limiting their ability to: 1. Effectively and responsibly use AI systems; 2. Question and challenge

AI outputs and role(s) in news production, or to adapt and shape them; 3. Report responsibly on AI and algorithms in society for audiences.

Our research indicates a foundational component of making AI intelligible to journalists will involve making it visible. This means both within technology (e.g. by flagging up AI component presence in a system, designing explanation interfaces, see for example Simkute et al. 2021) and within the social environment (e.g. by surfacing its role in news production, how it mediates social relationships etc.). Interrogating journalists' notions of computational journalism, Bucher argued that "computational journalism should not be seen as a thing or matter of fact, but rather as a 'process of articulation', whereby different elements are forged into non-necessary linkages that come to appear as if it was a unity" (Bucher 2017b: 919). She contends that discourse is "productive of social worlds, helping to temporarily stabilize and fix meanings" (Bucher 2017b) - a dynamic recognised by others studying invisible and abstract algorithmic assemblages (e.g. Seaver 2021). From this view, AI can be seen as a performative rhetorical construct and engaging with journalists' folk theories will be key to understanding their reactions and resistance (DeVito, Gergle, and Birnholtz 2017) - and indeed their views on how AI ought to be used, or not, thereby eliciting requirements and recommendations for editorially aligned AI (Gutierrez Lopez et al. 2022). Using these insights to depict important components of AI in legible ways will also be crucial, for example by devising icons (Lindley et al. 2020), using design thinking approaches such as sketching (Doherty and Worthy 2022), or research through design (RtD) methodologies as tools for engagement and education.

We found AI to be one element of a broader algorithmic infrastructure, which is embedded and "sunk" into the structures, social arrangements, and technologies of news production. AI as infrastructure both shapes and is shaped by the conventions of the journalistic community of practice but the balance of influence currently appears highly skewed against journalists exerting intentional and meaningful influence. Journalists reported paying attention to this infrastructure when it stopped working but crucially, it was not at all clear that they could recognise important instances of breakdown. For example, how they would know if an ML dataset on which one of their tools relied was biased (i.e. 'broken/not working as it should) or how they would identify if an algorithmically filtered feed they used was for instance hiding, demoting, or promoting things it should not. What it means for something to be 'working' in the context of these data-driven adaptive systems is different to prior technologies and it will require multi-stakeholder interventions to ensure their governance in critical or high-risk applications of AI in news.

We argue that the lack of visibility of AI and algorithmic infrastructures underpinning many newsroom technologies - a *perception* issue - is contributing to a knowledge vacuum that is being filled by guesswork, which commonly sees journalists transferring concepts derived from depictions of AI and algorithms in popular culture to the technologies they encounter at work - a *conception* issue. This poses several challenges to news organisations that aim to integrate complex algorithmic, statistical, and ML-driven systems responsibly and in ways that align with, or even augment, professional frameworks, such as public service media. First, the lack of a conceptual scaffolding of informed, situated, and contextualised ideas on which journalists can build leaves an

unstable and unsettled context ripe for misunderstanding, misuse of systems, and manipulation. Second, if as a community, journalists generally lack a grounded understanding of these systems as they exist in reality, they will struggle for an entry point into discussions of the relevance, possibilities, and limitations of these systems and as a result will risk exclusion from decision making contexts concerning the development and application of AI in the newsroom. They could also struggle to effectively report on their relevance for society as a result of not 'seeing' them embedded in social structures around them and risk failing to identify the new power dynamics shaping peoples' lives.

In light of our findings of the difficulty pinning down AI in the BBC and its widespread but scattered nature, we suggest news organisations make efforts to identify priority areas on which to focus attention by considering where AI becomes *editorially significant*. This requires asking questions of epistemology about where it plays a meaningful role in the production of knowledge claims, interpretation of information, and what counts as truth. AI is *not everywhere*, but *nor is it nowhere* and the important point to make here is that it is located in a very particular *somewhere* – the public service media context. This means determining how it should be applied in news must be through the prism of the values and priorities of that context, which necessitates hearing the voices of, and working with the journalists who enact those values.

On a practical level, we recommend public service media develop strategies for improving the intelligibility of AI and fostering AI literacy – advice Deuze and Beckett put forward for the industry more widely (2022). Such strategies could leverage existing inclusive design interventions more commonly employed in research and development cycles as a way to a) provoke reflection by newsworkers of their experiences with, and understandings of, AI and algorithmic systems, b) foster articulation of journalistic values and illuminate their application in practice in relation to such systems and c) generate a sense of agency - and indeed cultivate a real agency - amongst these domain experts in relation to emerging algorithmic systems. In the short term, these interventions could for example be workshops in collaboration with developers and data scientists that take systems currently in development as probes or provocations, and deliberately create points of friction to stimulate conversation with editorial colleagues around what would be acceptable, desirable, and consistent with journalistic workflows and epistemic frameworks.

Taking intelligibility of AI seriously without some degree of critical awareness, journalists cannot effectively question, criticise, or contribute to shaping AI systems or influencing what role they play in the construction of journalistic knowledge. If we recognise knowledge and communication as productive forces (alongside practice and production) in journalism, it becomes clear that the understandings and articulations of AI and algorithms within the journalistic community will impact their epistemic cultures as well as the news they produce. Laying the responsibility for misperceptions and lack of (critical) awareness of highly complex, often invisible technologies at the feet of journalists is unhelpful and unfair, especially considering increasing up-/re-skilling pressures (Min and Fink 2021).

We propose that news organisations, and public service media in particular, should develop strategies for making AI and algorithms intelligible for their journalists and that doing this could in fact offer an opportunity for journalists to reflect productively

on the norms and values imbued in the work they do. Ensuring responsible, ethical, and professionally appropriate engagement with AI-driven systems should of course involve journalists developing robust ways of working with intelligent systems but the responsibility for this should be distributed. Revisiting the levels of risk we identified, we suggest that as part of a holistic strategy, approaches should be targeted at:

a. *The individual level* - of the journalist to build critical and professional literacies, which begins with generating awareness and engagement. This will also require the *design of intelligible interfaces* crafted to support responsible decision-making by facilitating (rather than disrupting) journalists' application of expertise via exercising meaningful agency (e.g. correctly interpreting outputs, understanding limitations, being able to override outputs or stop use (European Commission (EC) 2021)).
b. *The organisational level* - to build effective support and governance that specifically tackles the issue as it relates to news production. This may include developing auditing structures, providing educational resources and new roles (e.g. curricula and access to experts or building new capacities into teams.)
c. *The community level* - to build professional resilience to wider changes in the journalism ecology (e.g. collaborating to build journalism specific AI-driven tools and applications, guidelines and mechanisms for translating ethical frameworks into practice (see Morley et al. 2020)).

There is increasing recognition that 'product', 'service', and technology decisions are *inherently editorial* and *ethical*. Diakopolous concludes that journalists and other designers of algorithmic media "need to be more deliberate about the values they are building into systems" (2019: 241). Foregrounding the evolution of computational journalism as a "human-centred endeavour", he argues that "expertise and intuition need to be reified to the greatest extent possible, as rules or data, if they are to be embodied in technology" (Ibid: 242). Designing and building explainable systems and intelligible interfaces are important considerations and will require involvement of expert practitioners through participatory methods, to elicit editorial and ethical requirements specific to the journalism domain to ensure domain agnostic applications of AI can be rendered contextually appropriate and subject to oversight and intervention. Based on our research we argue that (re-)framing intelligibility as a situated socio-cultural problem, rather than simply a problem in terms of a users' interaction with a system - helps us move beyond the dominant lens of technical solutionism and re-introduce normative domain-specific concerns that could help PSM recentre public service as a core pillar in algorithmic systems of news production.

Conclusion

We set out to examine how the BBC was using AI in news production and what its journalists' understandings of AI and algorithms were. We found that the data supported our two interrelated propositions: that AI was being increasingly used and there was a lack of intelligibility among the journalistic community on the ground.

Using insights from this case study, we argue for a reframing of the problem space and have developed recommendations for news organisations to address this intelligibility challenge. It is now widely accepted that algorithmic systems embody particular sets of values and provoke new distributions of power in journalism. This shifts influence to a subset of technical experts and companies that entail particular ontological and epistemological commitments that are different from those of public service journalism. Our review of academic and industry literature coupled with analysis of how AI intersects with news at the BBC indicates increasing ubiquity of AI in the journalism industry, including public service arenas. This comes with the caveat that most smaller and less well-resourced newsrooms have little or no direct development and procurement of AI systems but must still operate in an information ecosystem increasingly shaped by such systems. Our interview data, though based on a limited and relatively homogeneous cohort, suggests BBC journalists have a limited awareness and understanding of AI and how it relates to journalism, use guesswork and imagination when discussing AI and algorithms, and have a desire to know more. This suggests a disconnect between change in news production technologies and the levels of understanding of the nature of these systems. This disconnect could limit journalists' ability to effectively and responsibly use AI systems, to question and challenge their outputs and their role(s) in news production, or to adapt and shape them - as well as limit their capacity to report on AI and algorithms in society for their audiences. We recognise the limitations of this case study approach, which is not representative of the diversity of journalists either nationally or globally.

We argue that news organisations would benefit from making AI and algorithmic systems more visible and intelligible to journalists as this would serve to open up these seemingly mysterious systems to the scrutiny of domain experts and generate the potential for purposeful (re-)shaping. We make a series of recommendations for fostering AI intelligibility at the level of individual journalist, organisation and professional community and suggest that (re)framing the AI intelligibility problem in sociotechnical terms will have wider applicability to the research agenda for AI in news production.

Note

1. This has led to a growth in conferences, workshops, and networks across and between disciplines, including notably the Association for Computing Machinery Conference (and Network) on Fairness, Accountability, and Transparency (ACM FAccT) https://facctconference.org/index.html

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