Algorithms and Journalism: Exploring (Re)Configurations

Editors

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Editorial

Algorithmic Actants in Practice, Theory, and Method

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Abstract
What changes as algorithms proliferate within journalism and become more sophisticated? In this essay, we synthesize the articles in this thematic issue, which offer empirical evidence for how algorithms—and especially those designed to automate news production—are being incorporated not only into journalistic activities but also into the logics of journalism itself. They underscore that journalists have neither feared nor rejected such algorithms, as might be expected given the recent history of technological adoption in journalism. Instead, journalists have sought to normalize the technology by negotiating them against existing values and practices, and perhaps even reified some normative ideological constructs by finding unique value in what they offer as humans. These articles also highlight the shortcomings of those algorithms, giving pause to postulations of algorithms as potential solutions to shortcomings of trust in news and market failures. Indeed, such algorithms may end up amplifying the very biases that seed distrust in news all the while appearing less valuable to readers than their human counterparts. We also point to new opportunities for research, including examinations of how algorithms shape other stages in the journalistic workflow, such as interviewing sources, organizing knowledge, and verifying claims. We further point to the need to investigate higher analytic levels and incorporate additional perspectives, both from more diverse contexts (e.g., Global South) and from our sister academic fields (e.g., human–computer interaction). We conclude with optimism about the continued contributions this stream of work is poised to make in the years to come.

Issue
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1. Introduction

Journalism and technology are inseparable. While this is not a novel phenomenon, scholars have examined in recent decades the digital transformation of news, as pens gave way to keyboards, printing presses to content management systems, and postal services to internet service providers and social media (Zamith & Braun, 2019). However, although technology has historically been an ever-present partner, it was just that: an aide to a human-led endeavor.

In some sectors of journalism, this has changed. Algorithmic actants—software that follow a prespecified set of instructions to computationally transform some input into different output—are no longer just partners (Lewis & Westlund, 2015; Zamith, 2019). With growing independence, they now report and write stories, automatically adapt and disseminate content across multiple

information channels, and personalize journalistic products based on information about individual news consumers (Diakopoulos, 2019; Haim & Graefe, 2017). In these instances, it is the human that is the aide in an algorithm-led endeavor.

With this in mind, we organized this thematic issue around the idea of what changes as algorithms proliferate within journalism and become more sophisticated. How are existing activities, relationships, roles, and rewards reconfigured? To what extent do those reconfigurations require scholars to revisit existing theories and methods for understanding emerging assemblages, practices, and norms? These questions are not intended to convey technological determinism. Rather, they recognize that technology has long played a crucial role in journalism and merits special attention in today's media environments, even as technology in journalism is itself shaped by and implicated in broader questions about culture, politics, and economics (Zamith & Braun, 2019).

The articles in this thematic issue address some of these questions but also reveal something about our current moment as a field. Specifically, they demonstrate a fascination with *automation*: Nearly all concern themselves with the perceptions and impacts of algorithms used to independently perform news production activities previously carried out by humans. As this extensive connection to automation was dominant among nearly all of the submissions offered, we believe this is, at least in part, a reflection of the dominant discourses about the future of journalism, which emphasize economic insecurity, computational efficiency, and audience fragmentation and empowerment. These are not outlandish beliefs, of course. Traditional business models have buckled (Chyi & Tenenboim, 2019), we remain in an era of 'big data' and computational fetishization (Wu, Tandoc, & Salmon, 2019), and audiences are scattered across platforms and devices and expect some degree of control over the content they consume (Engelke, 2019).

However, the articles in this thematic issue suggest that, as manifested in contemporary practice, automation-induced changes are generally modest insofar as they only apply in certain scenarios, are typically not very sophisticated, and do not significantly trouble journalists. This is not to say that journalism is immune to automation—there is ample evidence that some change has already occurred and that many more fundamental transformations are likely yet (Diakopoulos, 2019). But the discrepancy between the rhetorical and empirical does remind us of the near-term obstacles to such change within the space of journalism, from the technical challenges of replicating the art of interviewing to the cultural challenges of advancing civic-minded and human-centric pursuits.

2. Advancing Our Understanding of Algorithms

The contributions to this thematic issue help us better understand some of those challenges, which apply not only to the space of automation but also to broader algorithmically oriented actors and activities.

Kunert's (2020) interviews with data and software providers and media outlets in Germany's sports journalism space found that the actors involved in news production believed that automated journalism offered added value for their readers—for example, it could cover events that might otherwise be ignored—but still believed human intervention was necessary for preserving quality. Kunert further notes that automation is currently used most often to write less-important and peripheral stories, and is therefore more of a complementary tool for journalists. Thus, although automated journalism introduced new actors, actants, and activities to the space of journalism, its traditional practitioners did not believe a serious reconceptualization of their social roles as journalists was needed.

Schapals and Porlezza's (2020) interviews with German journalists outside the genre of sports echoed some of those findings. They similarly found that journalists did not feel threatened by algorithms designed to automate their work. Instead, they believed automation would free them from monotonous, day-to-day stories and allow them to focus on more meaningful, in-depth stories—which they believed could not be easily automated. Moreover broadly, Schapals and Porlezza's interviewees drew upon traditional role conceptions in articulating a defense of their human contributions. Consequently, as the authors argue, automation has reified rather than replaced traditional role conceptions and thus promoted ideological continuity in the face of potential disruption.

Peterson-Salahuddin and Diakopoulos (2020) also found, through interviews with U.S. journalists, that social media algorithms were perceived to be most influential to editorial decision-making when the algorithm's indication of newsworthiness aligned with traditional understandings of newsworthiness. Put differently, journalists did not believe their editorial logics were determined by algorithmic feedback. Instead, such feedback was used in a complementary fashion, alongside traditional journalistic norms, for informing different gatekeeping decisions. This leads Peterson-Salahuddin and Diakopoulos to conclude that while social media algorithms have complicated gatekeeping practices, journalists still draw heavily upon traditional values in their decision-making.

Leppänen, Tuulonen, and Sirén-Heikel (2020) call attention to the ways in which the algorithms that power automated news production can become intentionally and unintentionally biased. They aptly illustrate why the myth of the 'mechanical objectivity' of algorithms is problematic, and advance the discussion by highlighting both the overt ways in which humans may introduce biases and the subtle ways in which actants may amplify them. Leppänen and colleagues also seed future work aimed at auditing algorithms by proposing strategies for evaluating algorithmic biases that take into account different

levels of cooperation from the system's owners. This is important given that many such algorithms are not only proprietary but effectively 'black boxes' that are methodologically challenging to evaluate.

Graefe and Bohlken (2020) observe in a meta-analysis of ten studies comparing readers' perceptions of computer-generated and human-written news that there was no difference in perceptions of credibility, a very small preference for human-written news in terms of quality, and a sizable preference for human-written news with respect to readability. However, when explicitly told about the authorship of a story, participants generally provided higher ratings across credibility, quality, and readability if the author was a human. This pushes back against arguments that audiences perceive algorithms, and their 'mechanical objectivity,' to be superior to and more trustworthy than their human counterparts.

Collectively, these articles offer empirical evidence for how algorithms—and especially those designed to automate news production—are being incorporated not only into journalistic activities but also into the logics of journalism itself. They underscore that journalists have neither feared nor rejected such algorithms, as might be expected given the recent history of technological adoption in journalism. Instead, journalists have sought to normalize the technology by negotiating them against existing values and practices, and perhaps even reified some normative ideological constructs by finding unique value in what they offer as humans. These articles also highlight the shortcomings of those algorithms, giving pause to postulations of algorithms as potential solutions to shortcomings of trust in news and market failures. Indeed, such algorithms may end up amplifying the very biases that seed distrust in news all the while appearing less valuable to readers than their human counterparts.

3. Opportunities for Future Work

The growing integration of algorithmic actants into journalistic logics opens up new pathways for evaluating their interdependency with human actors and the potential biases they mitigate and reinforce. In light of an increasingly institutionalized relationship, the design, development, and deployment of algorithms not only potentially affects journalistic processes and proclivities but may actively shape everyday coverage, too. However, while algorithmic actants have been shown to impact newswriting, news distribution, and audience perceptions, far less is known about how they shape other stages in the journalistic workflow, such as interviewing sources, organizing knowledge, and verifying claims. Those areas strongly merit further scholarly attention.

Moreover, much of the literature to date focuses on case studies and micro-level comparative analyses. These offer essential steps in theorizing algorithmic actants within journalism studies. However, in order to continue to move this stream of work forward, it is necessary to investigate higher levels and additional perspectives—certainly those beyond North America and Europe. This opens room to investigate the extent to which distinct journalism cultures moderate and accentuate certain beliefs and practices, and further how new organizational structures and economic models may be emerging alongside and in response to algorithmically enabled affordances.

Finally, much of the work in this space to date has been qualitative or conceptual in nature, aiming to describe and make some sense of these developments. These works have been essential to developing our understanding, but they also run the risk of becoming limited by methodological and theoretical homogeneity. To that end, we encourage scholars to consider additional theoretical perspectives—including those from our sister fields of human–computer interaction and organizational studies—as well as computational methodologies that aim to capture nuances about what and how algorithms perform as they are deployed within journalism. Ultimately, we remain very optimistic about the continued contributions this stream of work is poised to make in the years to come.

Acknowledgments

Conflict of Interests

The authors declare no conflict of interests.

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Article

Automation in Sports Reporting: Strategies of Data Providers, Software Providers, and Media Outlets

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Abstract
This study examines how algorithmic processing affects structures and practices in sports journalism in Germany. A multi-level perspective is used to determine which strategies data providers, software providers, and media outlets use to develop automated reporting, which compiles perspectives across the entire line of news production. The results of 11 in-depth interviews show that non-journalistic actors are vital partners in the news production process, as all actors work together in data handling, training, and software development. Moreover, automation can generate additional content such as match and historical coverage to help address shortfalls in capacity. However, given the business case for automation, amateur football (soccer) is currently the only viable candidate for its use. Many actors involved in the process argue that automated content is an added value for their readers, but claim that content quality has to be put before quantity. This means that some media outlets edit automated articles to increase the quality of their sports journalism, but that this is done only on a small scale. Media outlets do not perceive their roles to be changing, but see automation as a helpful tool that complements their work; a few use automatically created articles as a baseline for in-depth reporting. Moreover, the so-called 'meta-writer' has not become a reality yet, as data-processing and news writing are still kept separate. This article sheds new light on the use of automation in the sports beat, highlighting the growing role of non-journalistic actors in the news production process.

Issue
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1. Introduction

This article examines how algorithmic processing affects institutionalised structures and practices in sports journalism in Germany. It assesses the strategies that data providers, software providers, and media outlets have devised regarding the development of automated reporting. This study focuses on how German sports journalism manages the balancing act between being a data-rich (and thus easily 'automatable') beat on the one hand, and the impact of economic constraints and journalists' perceptions of 'good' sports coverage on the other hand.

The sports beat is especially well suited to automation due to the extensive structured data available and its routine events (Galily, 2018; Graefe, 2016). While simple automation processes have been used for weather and earnings reports for quite some time (Graefe, 2016, pp. 19–20), sports recaps (namely baseball) were the first application for automation by the major natural language generation providers Automated Insights and Narrative Science (Allen, Templon, McNally, Birnbaum, & Hammond, 2010; Graefe, 2016, p. 17). While academics and journalists often emphasize that sports reporting requires (human) creativity and emotions (Horky

& Stelzner, 2013), which sets it apart from other data-intensive beats such as finance, media outlets have successfully used automation, especially in amateur sports reporting (e.g., WashPostPR, 2017). In this article, I explore how German sports reporting uses automation, and identify lessons for the future.

I conducted guideline-based interviews to investigate the perceptions of sports data providers, software providers, and media outlets regarding automation. This approach examines views throughout the news production process, as the study participants include journalists as well as non-journalistic actors who may influence the (re-)definition of journalistic self-conceptions, and whose role in the news process might change with automation (see Carlson, 2015, p. 417). I demonstrate how journalists and these "journalistic strangers" (Holton & Belair-Gagnon, 2018) interact with each other, and how they define their relationship in automating amateur sports coverage.

This study focuses on the *production* of automated news rather than *audience perceptions*. The latter has been studied extensively in general (e.g., van der Kaa & Krahmer, 2014) as well as in the case of sports (Yao, Salmon, & Tandoc, 2018). This research has found that readers are ambivalent in their perceptions of automated news, ranging from being unable to differentiate between automatically and human-written material (e.g., Clerwall, 2014) to distinctly preferring either machine-written (e.g., Jung, Song, Kim, Im, & Oh, 2017) or human-written articles (e.g., Graefe, Haim, Haarmann, & Brosius, 2018). Although I did not survey the audience, it stills plays a major role for both journalists and journalistic strangers, as both anticipate audience reactions: The readers motivated initial decisions to automate, and their feedback sparks efforts to adjust the software settings for future articles.

The article begins with a literature review of automated journalism and its use in sports reporting. It then presents the methods and discusses the results. The article concludes with a discussion of the use of automation in sports reporting and areas for further research.

2. Literature Review

2.1. Automated Journalism in the Newsroom

Algorithmic processes are used to select, create and distribute news content. Automated content creation, using natural language generation, is defined as "algorithmic processes that convert data into narrative news texts with limited to no human intervention beyond the initial programming" (Carlson, 2015, p. 417). In principle, this definition also applies to the automatic creation of news videos and visualisations (e.g., Alhalaseh et al., 2015).

The automated composition of news texts proceeds in three steps (Dörr, 2016, pp. 703–704). The first step is inputting structured data. In sports, this is usually match day data, such as the number of goals, attendance, goal scorers, or yellow cards. The second step is the "initial programming" (Carlson, 2015, p. 417): A journalist creates a template that is later filled with data (Graefe, 2016, p. 17). To add variability to the news texts, synonyms and 'if-then-else' branches, for example decision rules for the algorithms to decide whether the match was an 'easy win' or a 'bad loss' for a team, can be programmed in. The last step is the output, i.e., the articles generated from the data.

Automated journalism lends itself to data-intensive beats, such as crime, finance and sports (van Dalen, 2012). News agencies and individual news outlets increasingly use automated content creation (e.g., Fanta, 2017), such as the *Washington Post*'s Olympics coverage (Rojas Torrijos, 2019).

2.2. Changes in the Journalistic Profession through Automation and Journalistic Strangers

Automation processes have been found to heavily impact the journalistic profession, for example working routines and self-conceptions. Journalists generally feel optimistic about automated news reporting, as it frees them up from conducting grunt work and lets them report on in-depth issues (Wu, Tandoc, & Salmon, 2019, p. 1451). They are adapting to these changes by "re-examin(ing) their core skills" (van Dalen, 2012, p. 649); automation is not perceived as a threat, but rather as a form of hybrid work in which journalists maintain control over news generation (Graefe, 2016; Thurman, Dörr, & Kunert, 2017; Wu et al., 2019).

Carlson (2015, p. 423) finds that journalists either augment their core skills by becoming "meta-writers" who acquire computational skills and thinking (Gynnild, 2014; Lindén, 2017a), or outsource these skills by dividing tasks with programmers (Lindén, 2017b, p. 132). Carlson (2015, p. 417) classifies this negotiation of journalistic roles as a "technological drama," in which journalists have to redefine their roles while "technologists" find their way into newsrooms. Therefore, research on news automation must examine journalists as well as non-journalistic actors such as data and software providers.

Holton and Belair-Gagnon (2018) classify these non-journalistic actors as 'journalistic strangers,' who shape journalistic innovation and challenge the profession to evolve by introducing new perspectives and tools such as web analytics and programming. In the case of article automation, the journalistic strangers are mainly data and software providers, who are external to the news outlets, yet have vital tasks. They enter the news production process as "implicit interlopers" as they drive innovation by offering "potential contributions and improvements" (Holton & Belair-Gagnon, 2018, p. 74) to journalism, i.e., enhanced content and connection to audiences. Unlike "explicit interlopers," such as independently run blogs or the disclosure platform WikiLeaks, implicit interlopers do not challenge journalistic authority (Eldridge, 2019). They are generally welcomed to newsrooms, even

though this may be the result of a longer negotiation process of journalistic values and role perceptions (Chua & Duffy, 2019), which is also the case for automating content generation (Thurman et al., 2017).

For article automation, implicit interlopers are the main drivers of innovation, as they contribute the necessary technological aspects such as software platforms and data. These types of interlopers are not mere service providers working at the periphery of news production; they are powerful actors at the very heart of it (Ahva, 2019, p. 124; Tandoc, 2019, p. 141). This is surprising, because in the case of software providers, journalistic articles are not their main product, but rather "product descriptions, portfolio analyses, or patient summaries in hospitals" (Graefe, 2016, p. 19). Despite their central role as providers of the main infrastructures for automated sports content, readers are often not aware of their existence, as content may not be labelled as automated, but simply contain the brand of the news outlet (Braun, 2014, pp. 124–125).

Individual journalists' perceptions of these journalistic strangers seem to depend on the news beat. For instance, Thurman et al. (2017) found that finance journalists and editors felt positively about automation, whereas sports journalists vehemently opposed it. These discrepancies warrant a closer look at the sports beat.

2.3. Impact on the Sports Beat

The sports beat is a good candidate for article automation since it has routine events that can be covered instantaneously and at high volume using this technology (Galily, 2018; Graefe, 2016). Moreover, extensive structured datasets are collected and available, for example via OPTA (2020). For popular sports, such as football [soccer] in Germany (Allensbacher Markt und Werbeträgeranalyse, 2019), data are also collected for local events such as regional leagues. Without automation, these leagues would not be covered in the media due to a lack of personnel and resources (van Dalen, 2012, p. 652), which means that this type of coverage finds small, yet likely loyal, audiences (Carlson, 2015, p. 426). Moreover, automation allows articles to be sent out quickly, giving journalists time to work on in-depth reporting (Lindén, 2017a; Thurman et al., 2017, pp. 1249–1250), such as personal stories of coaches and players. The use of automation may thus be regarded as a service to loyal readers as well as a sound business investment for extending sports coverage (Boyle, 2006), achieved with the help of implicit interlopers, especially software providers. However, commercially used software templates only cover a limited number of sports (e.g., football in the case of Retresco's textengine), although non-commercial prototypes have been created, for example, for cricket (Gunasiri & Jayaratne, 2019) and ice hockey (Kanerva, Rönnqvist, Kekki, Salakoski, & Ginter, 2019).

Despite this potential, sports coverage has some characteristics that may hinder article automation and thus the involvement of implicit interlopers, as they profoundly change traditional processes of sports reporting. For instance, when reporting on a match, the context beyond the match statistics such as goals or yellow cards must be taken into account. However, such in-depth data that would help journalists who were not present adequately describe a match are often unavailable, especially for amateur leagues (see Lindén, 2017b). As a sports reporter said in Thurman et al.'s (2017, pp. 1247–1248) study, "the data might only present '10 percent of the story.'" He thus found a crucial part of reporting missing when asked to assess the quality of automatically created articles, and felt that these articles were "throw away, repetitive, not particularly interesting" (Thurman et al., 2017, p. 1248).

Another sports journalist in Thurman et al.'s (2017) study claimed that automation can help discover stories in the first place, especially when the data defy what he called "accepted wisdom" in sports (Thurman et al., 2017, p. 1248; Wu et al., 2019). This resembles the notion of a "hybrid collective" of an enhanced human–machine connection (Primo & Zago, 2015), yet shows that sports journalists in Thurman et al.'s (2017) study saw automation as merely a tool in the newsroom, but not one that writes publishable news stories.

Sports coverage is also associated with emotion and storytelling (Horky & Stelzner, 2013), which has not yet found its way into factual automated reports (Yao et al., 2018). However, it can be questioned whether results-led reporting requires an individual journalistic voice, as such coverage is usually done in fixed templates, and reads similarly to automatically created output (see Carlson, 2015, p. 425).

In addition to style issues, sports journalists have been found in early studies to be generally weary of automation technology. In describing journalists' reactions to StatSheet, a now defunct sports statistics website, van Dalen (2012) found that sports journalists felt they were competing with the underlying algorithm (p. 652), a sentiment echoed by Carlson (2015, pp. 422–423). The current dominant notion of a "hybrid collective" (Primo & Zago, 2015) between journalists and algorithms emphasises separating automatised routine tasks done by machines from skills that require humans (for the distinction between "low" and "high" journalism, see also Lindén, 2017a, p. 65). Instead of competing with the algorithm, van Dalen (2012, p. 653) advises sports journalists to "concentrate on their own strengths," and on "the human advantage of telling the story in the sporting world" (Galily, 2018, p. 50).

I aim to disentangle the relationship between the sports beat and automation, represented by the involvement of implicit interlopers, with a holistic view of the whole news production line, consisting of data providers, software providers, and news outlets. I focus on the case study of Germany, a big sports market with an emphasis on football:

RQ: How do data providers, software providers, and news outlets perceive and work with article automation in German sports reporting?

3. Methodology

I conducted interviews on the use and perceptions of article automation in German sports journalism and assessed them using qualitative content analysis (Schreier, 2012). I incorporated views from the entire production line of automated journalism, thus examining how journalists and implicit interlopers, namely data and software providers, assess their relationship and working processes (Ahva, 2019, p. 125; Holton & Belair-Gagnon, 2018, p. 76). Thus, I interviewed two providers of sports data, three software providers, five news outlets, and representatives of the German Football Association (DFB) between March 2018 and April 2020 (Table 1).

Starting with the interlopers, OPTA and Sportec Solutions are the most prominent data providers for sports data in Germany. For the software providers, AX Semantics and Retresco were interviewed. Retresco provides the 'textengine' used by many media outlets, including those interviewed for this study. ReportExpress is an app that provides software for reporting on amateur football matches. It is classified as a software provider since it focuses on producing content and is not a news outlet (its articles are not published in the media, but can be downloaded by its users). To account for a range of views from news outlets, I interviewed outlets with different strategies for automation in sports reporting: the online portal *OVB24*'s *Beinschuss* (in German: nutmeg or tunnel, a sports term), which covers amateur football in Upper Bavaria; *Der Spiegel*, which uses large volumes of data and some automation for sports news projects, but does not plan on implementing automation

to create text; *FussiFreunde* (in German: football friends), which covers amateur football in Hamburg; *Nordbayern Amateure* (in German: Northern Bavarian amateurs), which reports on amateur football in Middle Franconia in Bavaria; and *Sportbuzzer*, which previously used automation for their amateur football reporting in the Bremen area but has since stopped. *Fussball.de* (in German: football), run by the German Football Association, is the biggest provider of automated reporting on German amateur football. The German Football Association presents a special case, as it is an implicit interloper that covers amateur matches similarly to media outlets. However, the German Football Association claims that they have no journalistic aspirations and do not challenge journalistic authority, as their sole aim is to provide a service for their amateur leagues.

The first few interviews with data and software providers conducted for this research demonstrated that automated journalism is viable only for football in Germany, which is why the sample focuses on this sport. The interviews averaged one hour (range: 32 minutes to 2 hours). They were conducted in person (2), via telephone (6), via video chat (2), and via e-mail (1).

This sample offers an adequate overview of German news outlets' experiences with automation in sports coverage. Only a few software companies offer text automation for sports; Retresco is the main provider of this service. All five news outlets I interviewed use (or previously used) Retresco's textengine, and their accounts of the software differ only in details. Thus, other news outlets would likely report similar experiences. However, I did not interview outlets that use AX Semantic's platform. Moreover, as media outlets often do not label automated articles, identifying possible interviewees was not easy, which might mean that strategies regarding automation other than the ones presented were missed. Lastly, there

Table 1. Interviewees.

Type	Company/Outlet	Name	Position
Data provider	OPTA	Sven Tröster	Chief editor, Germany and Switzerland
Data provider	Sportec Solutions	Holger Rahlfs	Head of product
Software provider	AX Semantics	Frank Feulner	Chief visionary officer
Software provider	Retresco	Johannes Sommer	CEO
Software provider	ReportExpress	Gabriel Brass	CEO
Media outlet	Beinschuss	Martin Vodermair	Editor in chief
Media outlet	Der Spiegel	Patrick Stotz	Data journalist
Media outlet	FussiFreunde	Dennis Kormanjos	Editor
Media outlet	Nordbayern Amateure	Bastian Eberle	Team leader, amateur football
Media outlet	Sportbuzzer	Steffen von Deetzen	Product manager for the introduction of automation
German Football Association (DFB)	Fussball.de	Dr. Frank Biendara Anja Vianden	Managing director, DFB GmbH Project manager, robot journalism

is only one media outlet in the sample for which automation was not successful, meaning that there is not a balance of critical voices.

Interview questions fall into five categories: 1) workings of automation (viability for different sports, data collection systems, software systems, introduction of automation at news outlets, successes and obstacles associated with automation); 2) working with automated articles (article quality, types of customers of data and software providers, possible extension of the use of automation, editing practices at news outlets, reader reactions, practice of labelling articles); 3) working with the software (training of the software, journalists' technological skills, potential and limits of the software, working together across the journalistic production line); 4) data availability and maintenance (data depth and sources, maintenance, reaction to errors); 5) and change in sports reporting through automation (journalistic self-perceptions, changes in the profession, dangers and limits of automation for journalism, possible advantages of human journalists). The full interview guide is available in the Supplementary File.

The coding was structured by deductive categories derived from the literature on automation. These codes concerned the reception of automation in the respective newsroom and its impact on journalistic self-perceptions, the positive impacts of automation (e.g., saving time, exploring new story formats) as well as the negative aspects (e.g., no context, low quality), data availability, business considerations (e.g., cost), and user/reader feedback. New categories and codes were created inductively, which concerned mostly the interloper–media outlet relationships or were specific to sports (Schreier, 2012). These included working together across the production line, software development, possible business cases for sports other than football, the heightened importance of putting automated sports content into context, and, in the case of media outlets, creating a bond with local readers.

4. Results and Discussion

I identified four main themes: 'Actors: Working Together,' 'Content: Additional Coverage,' 'Money: Football Only,' and 'Quality: The Art of (Human) Sports Reporting.' These themes demonstrate the deeply intertwined relationship between journalists and implicit interlopers (Holton & Belair-Gagnon, 2018), showing their common working routines, the impact of the innovations that the interlopers contribute to newsrooms, how these innovations are affected by economic considerations, and how the innovations are negotiated through the lens of journalistic self-conceptions.

4.1. Actors: Working Together

The implicit interlopers are deeply involved in the working routines of automated journalism. Their work in data handling, the training of journalists and newsrooms, and software development is a prerequisite for automated journalism. However, the interlopers' work is mostly separate from editorial work, and journalists are only involved in the technological processes to a limited degree.

4.1.1. Data Handling

As media outlets often have limited experience with data handling, data providers OPTA and Sportec Solutions assist their customers in selecting valid data for their reporting. Sportec Solutions highlight making data "consultable" for their customers, and emphasise that "the whole processes of refining match data according to the customer's wishes stays in our [Sportec Solutions'] hands." OPTA also advise customers on how to implement data. Even though both companies mainly work with professional football data, Sportec Solutions' assessment also applies to amateur data: "It's more economic if specialists do that [data handling], as it is not the customer's core business to work with data and operate a database." Thus, there is a clear distinction between data collection and preparation on the one hand, and data usage by media outlets on the other. Moreover, software providers often act as brokers between data providers and media outlets. However, there are exceptions, such as the Bavarian Football Association, which brokers its own data without intermediaries (*Beinschuss*, *Nordbayern Amateure*). This approach to data handling echoes Lindén's (2017b) call to divide tasks between programmers and journalists, and shows that data providers offer an innovative service that newsrooms cannot deliver themselves.

4.1.2. Training of Journalists and Newsrooms

As data handling is largely out of the media outlets' hands, so is tinkering with the automation software. Both AX Semantics and Retresco offer their customers basic training in using their software; the aim is for newsrooms to manage the software independently. However, this training does not include teaching customers how to fundamentally reprogram the software. According to Retresco, the underlying algorithm is complicated, which is why their software "looks much like [Microsoft] Excel." Thus, journalists may only input basic "rules for data interpretation," such as "synonyms for club names in singular and plural" (*Nordbayern Amateure*) or "team nicknames" (*Beinschuss*), so that the "texts don't always look the same" (*FussiFreunde*). *ReportExpress* also simplify working with their app by offering plug-and-play reporting, in which users "simply tap action and decision buttons" that, for example, describe the weather or the speed of the match. These limited options for working with technology contradict the prediction that journalists will acquire computational skills and thinking (Carlson, 2015; Gynnild, 2014; Lindén, 2017a). In fact, according to *Beinschuss* and *FussiFreunde*, to operate Retresco's tex-

tengine, one "doesn't need technological skills at all," as "just the index finger" (*Nordbayern Amateure*) suffices. These accounts differ heavily from the interviewee from *Der Spiegel*, who works with raw data and advocates having advanced software skills. He thus resembles the "meta-writer," as he distinguishes between "data journalists and traditional editors." However, journalists working with automation software do not program it themselves; they rely on a pre-set product.

4.1.3. Software Development

The software providers state that they continually improve the functionality and usability of their software. However, Retresco questions if more development was necessary for its language quality, asking "whether the football texts we now have are good enough." This sentiment echoes Carlson's (2015, pp. 424–425) finding that journalists generally claim that automated texts are of acceptable quality, as they mimic a "wire-service-style news story" that has no individual journalistic voice anyway. However, Retresco's assessment demonstrates that data and software providers introduce a new set of rules to sports journalism, which is guided by the opportunities the technologies provide as well as their limits, in this case the language and structural capabilities of the software (Tandoc, 2019, p. 141). Moreover, these capabilities have to be extensively defined. *Fussball.de* say that it took "a lot of manual work" to program the software and make it "talk sports" by, for example, adding "metaphors and idioms." For this programming, *fussball.de* employ a dedicated project team of "sports journalists, machine learning specialists, software specialists and linguists" that set up the software in the first place and continues to work on modifications. Thus, implicit interlopers are not only welcomed, but are invited to the news process in order to define the rules and semantics of automated sports coverage (Graefe, 2016, p. 18). However, in this case, the German Football Association is an implicit interloper itself, working with other interlopers to create automated news.

Nordbayern Amateure report that software providers respond to requests from media outlets to add further functionalities. ReportExpress also receive "wish lists" from their customers, mainly amateur clubs, indicating that users are involved to some degree in software development. Interviewees' descriptions of the audience feedback on the automatically created articles mirrors the ambivalent findings of previous research (e.g., Clerwall, 2014; Yao et al., 2018). For instance, *Beinschuss* state that a club was not happy to be repeatedly called the "shooting gallery of the league," and asked for a change in programming, which *Beinschuss* did by eliminating this phrase from their copy of the software. *Fussball.de* also reacted to amateur clubs' feedback and adapted the software accordingly. In addition, *fussball.de* also allows team managers on both sides to edit the automatically created articles. Thus,

there could be three reports of a single match, created by "the software, the home team, and the away team." Around 80% of teams do not use this option, which supports *fussball.de*'s claim that their article quality is "very good.''

Other reader feedback claims that the automatically written articles were "not exciting" (*Sportbuzzer*), and generated fewer clicks than usual. However, most interviewees report positive feedback from their readers (Retresco, *fussball.de*, *Nordbayern Amateure*). *FussiFreunde* say their readers perceive automation to be "normal," as they receive very little feedback anymore. Retresco and *Nordbayern Amateure* also state that readers might not even notice they are reading automated content since it is often not labelled as such (Braun, 2014). In summary, readers' assessments are ambivalent, and some interviewees actively work on the quality of the articles to address readers' feedback.

4.2. Content: Additional Coverage

The implicit interlopers have produced innovative tools that introduce new opportunities to cover previously underreported amateur football and for in-depth statistical and historical reporting. These types of reporting are not innovative *per se*, but would require extensive manual work to perform without automation.

4.2.1. Solving the Capacity Problem

All interviewees confirm that automation helps media outlets increase the quantity of news while working with limited resources (Graefe, 2016). They agree that automated journalism increases coverage in areas where there was hardly any before, in this case amateur football (see van Dalen, 2012). AX Semantics and Retresco emphasise the possibility of serving large regions with few journalists, as:

> Automated reporting is in some cases the only reason why there is a full report instead of a simple table or a summary of several matches….Fans appreciate that we report on their village team in a way that resembles the Bundesliga. (AX Semantics)

Sportbuzzer, *FussiFreunde* and *Nordbayern Amateure* agree, as they lack the time and personnel to cover every match manually, especially concerning pre-match reports and team statistics.

All interviewees mention that their readers benefit from automation. *Beinschuss* emphasise that automation offers "additional value" for their readers, even though the articles may be written based on "rudimentary data." *Nordbayern Amateure* add that amateur coverage is a "service for lower leagues" that they could not deliver without automation. The implicit interlopers, the data and software providers, are thus welcomed into newsrooms to help media outlets address economic chal-

lenges (Tandoc, 2019, p. 141). *Fussball.de* also emphasise the notion of offering a "service"; the representatives state that they want to give amateur football "more attention, as they are hardly featured in the media," and to do so "nationwide" for all matches, including youth teams. These examples show that implicit interlopers may help in "cultivating stronger press–public relationships" (Holton & Belair-Gagnon, 2018, p. 74), as the expanded coverage brings outlets and audiences closer together, especially where there was no coverage before. *Der Spiegel*, albeit without using text automation, add that they use structured data to create value for their audience with "timeless" stories, such as their "Fan Atlas," which gives a data-driven overview of football fan friendships and rivalries in Germany.

AX Semantics see automation as a starting point for in-depth reporting, as newsrooms "can deliberately select matches which have high news value, and then report on them again manually." *Beinschuss* and *FussiFreunde* agree on the benefits of utilising automation to find a "news angle" to report on manually (Allen et al., 2010; Thurman et al., 2017), and do not view automation as a threat to the journalistic profession, but rather as a helpful tool that summarises data in an efficient manner.

4.2.2. Statistics and Historical Reporting

Automation helps detect historical statistics, which is efficient and saves time. For instance, an algorithm can assess the team's performance in the latest match to determine "how teams and individual players performed [during the season]" (AX Semantics). Sportec Solutions add that historical data offer opportunities for deeper storytelling through "historical contexts, peculiarities, records" or "form curves" (*FussiFreunde*), which may help to verify "perceived truths" (*Der Spiegel*). The speed with which historical data can be generated is also valuable for professional sports (*Nordbayern Amateure*). Sportec Solutions argue that even though professional football is reported on anyway and thus automation does not fill the same gap as in amateur football, automation may provide "original texts," so that media outlets do not have to use "news agency texts which might not differ across customers." Thus, the innovative work of implicit interlopers allows media outlets to work with new formats and engage in forms of storytelling that would have taken extensive manual work otherwise (Lindén, 2017a). Through this coverage, media outlets can form deeper relationships with their (sometimes very small) audiences (Graefe, 2016, p. 26).

4.3. Money: Football Only

Although the interviewees repeatedly mention the notion of offering a service to their readers, automation in the sports beat hinges on business decisions. All but one interviewee claim that automation in Germany is eco-

nomically viable only for amateur football; it is less applicable to other sports.

Retresco state that the focus on football is a business decision: "Everything apart from football would be more of a hobby [to customers]," as other sports would not bring sufficient financial revenue. *Der Spiegel* does not work with text automation, but say that "readership interest" is crucial for "very complex and time-consuming data stories." Therefore, football is the subject of most sports reporting "even if data might be available [for other sports]."

OPTA and Sportec Solutions both emphasise that data collection is in principle possible for many sports, as is automated news creation, especially "for team sports similar to football, such as handball, basketball or hockey" (ReportExpress). Other sports in which "style" (AX Semantics) matters might be more difficult, as well as sports "deviating from shooting goals or hoops, such as curling, sailing or fencing" (ReportExpress).

Only *Beinschuss* aim to use automation for other sports, namely winter sports. The *Beinschuss* representative says that winter sports face similar capacity and personnel problems, but stresses that this endeavour depends on data availability. Nevertheless, all interviewees acknowledge that using basic data from all sports would in principle be of interest to the media, for example for tennis (*Nordbayern Amateure*). Therefore, even though structured data might be available, and it might be possible to develop templates (e.g., Allen et al., 2010; Gunasiri & Jayaratne, 2019), these developments hinge on business decisions. Such decisions also affect professional football in terms of historical reporting, as collecting more than the basics would be "too expensive" with "probably little gain" (OPTA). Thus, the challenge does not lie with the implicit interlopers here, as they can in principle offer more data and templates; it instead lies with the news outlets, which have to find economically viable business strategies and negotiate the trade-off between offering a service to their readers and sufficient financial revenue.

4.4. Quality: The Art of (Human) Sports Reporting

The trade-off between offering a service to readers and economic considerations also applies to the quality of automatically generated articles. While media outlets generally appreciate the increase in the *quantity* of articles, some have *quality* concerns regarding their formulaic structure and language, as well as incomplete content due to limited data availability. The outlets employ a range of strategies to deal with these issues, such as editing the automated articles.

4.4.1. Quality Before Quantity

Quality concerns especially relate to the language and structure of automatically created articles. For instance, *Sportbuzzer* was the only outlet in the sample to decide

not to use automated reporting after a test run. It claims that even though human-written match reports often "resemble automated reporting," as many of them are written using a template (van Dalen, 2012), the quality of the automated texts was "not what we had imagined." As the automatically created articles had to be heavily edited for language, the outlet claims that automation did not save its employees any time. *Sportbuzzer*'s representative emphasises that they do not want to offer their readers this type of coverage, as sports reporting is about "bringing in something "real," such as a "coach's comment.''

FussiFreunde agree, and edit their articles, for example by adding quotes and further information, which teams even supply without being asked if a reporter cannot attend the match. *FussiFreunde* stress that they have a strong bond with their readers, and thus aim to add further information and "[bring] emotion to the facts" through exclusive reports, direct quotes, and storytelling (Horky & Stelzner, 2013). Thus, *FussiFreunde* still favours human reporting over automation, as they emphasise the "human advantage" (Galily, 2018; Graefe, 2016, p. 11), whereas automated articles serve as more of a baseline. Thus, these outlets recognise the advantages of automation, yet assert that journalists still oversee the process (Wu et al., 2019, p. 1454).

Nordbayern Amateure agree with putting "quality before quantity." They edit every automatically created text, for example when these are "too judgmental," and add further information such as "direct quotes." This kind of quality control—or, as Graefe (2016, p. 35) describes it, "man–machine marriage"—requires personnel, and thus *Nordbayern Amateure* contradict the notion that automation reduces jobs in journalism (Lindén, 2017a). The representative states the opposite: "Theoretically, we could even employ more people who operate the textengine.''

Beinschuss also cover "special events" manually, which automation gives them the time to do. They report that automation is a way for their journalists to "concentrate on their own, good stories, which they most certainly would rather put on their CV than pre-match or post-match reports." However, they acknowledge that automation is the only way to offer "a short report on every match," which they could not achieve manually. Trying to achieve this goal before automation led to reports of "relatively low quality" due to personnel and time constraints.

While some quality considerations might be a programming issue—AX Semantics claim that a human may indeed feed "humour, irony, sarcasm, emotional value" into the software—automation also faces limits in specific forms of coverage. Retresco report that programming tournament modes would be too complex; however, these are a vital part of the sport. In addition to programming limitations, quality is also affected by limited data availability.

4.4.2. Data Limitations

The availability of structured data is the most important prerequisite for automated journalism (Graefe, 2016). However, even though Retresco claim that "data availability might be the most important thing," amateur football in particular suffers from limited data availability. As rarely more than the basics, such as "lineups and goal scorers" (Sportec Solutions), are available, automated articles rely on relatively few data points. *Beinschuss* concede that "the machine doesn't recognise special events," so the course of the match might not be adequately reflected in the data (*Sportbuzzer*). Sportec Solutions agree: "The data only show a piece of the whole football or Bundesliga experience. When a player announces the end of his career, receives flowers and has tears in his eyes, then we can't see that in the data." Again, emotions play a big role for the interviewees, echoing one of the sports journalists in Thurman et al.'s (2017) study who complains that automated texts do not offer relevant context. Moreover, aborted or cancelled matches are often not noted in the data, which may lead to false reports (*Beinschuss*), which is one reason why *Nordbayern Amateure* edit every automated text before publication. *Beinschuss* and *Nordbayern Amateure* mention that since limited data are available from the regional Bavarian football association, additional sources have to be brought in for Bavarian outlets.

Apart from the issues arising when aborted or cancelled matches are not reported, most interviewees say their data are errorless, even though they have to be examined thoroughly for "completeness, potential outliers, mistakes" (*Der Spiegel*). Thus, "databases have to be maintained" (Retresco) continuously so that readers do not find (and report) mistakes (*Sportbuzzer*).

Some of these problems might be cured with further software development. According to AX Semantics, their software offers to include context by adding a second data stream on weather or press releases about players. ReportExpress do not use third-party data streams at all, but ask their users to enter their assessments of the match's atmosphere and other surroundings along with factual data such as goals and yellow cards. In terms of mistakes in the data, ReportExpress do not scan for data mistakes, as users are responsible for their own data entry, and say that it is their sole responsibility to care for the "error-free running of the app." AX Semantics assure that the software can detect obvious mistakes, such as reporting "21 [goals] instead of two."

5. Conclusions and Outlook

This study shows how data providers, software providers, and news outlets perceive and work with article automation in German sports reporting. I demonstrate that the working processes of these actors are deeply intertwined, which can be seen, for instance, in how data and software providers deliver the prerequisites of article au-

tomation, without which this type of journalism cannot be done. Moreover, software providers and media outlets jointly adjust the software according to the individual outlet's needs based on ongoing feedback that includes the audience's reception.

These examples show that "journalistic strangers" (Holton & Belair-Gagnon, 2018) are vital in the automated news production process. They bring about an innovative form of reporting that helps media outlets scale up the quantity of their amateur football reporting, allowing outlets to offer a service to the lower leagues in their region. These implicit interlopers, namely the data and software providers, thus bring new opportunities to news outlets without challenging journalistic authority. Their central role implies a power shift, as journalists depend on them during the news creation process, and work with them to produce articles (Ahva, 2019; Primo & Zago, 2015; Tandoc, 2019). The ongoing negotiation between journalists and interlopers manifests itself in the tension between offering a service to readers while adhering to the manifests of sports journalism, which includes emotion and storytelling (Horky & Stelzner, 2013). This negotiation mainly applies to software providers, yet data providers are included in this conversation regarding data quality concerns.

Despite the vital role of the implicit interlopers, media outlets do not view their role as diminished or feel they are in competition with the automation software (van Dalen, 2012). As *FussiFreunde* explain, "nothing changes at all for us journalists," as they still have to add meaning and emotion to the automatically created articles, staying firmly in charge of the published product (Wu et al., 2019). But even if the automatically created articles are not edited, they still add extensive value for the news outlets' readers, including by granting the journalists more time for interviews and other exclusive stories. However, as the *Sportbuzzer* case shows, not everyone reaps the benefits of automation. Quality considerations demonstrate that the sports beat might be a unique case with regard to automation, as many interviewees, including *Sportbuzzer*, noted that sports stories require context and further editing. Nevertheless, *Beinschuss* concisely summarises the value of automation: "Automation is definitely an added value for our readers. So why shouldn't we make use of this?" Future research could examine whether this is different for other beats such as finance, where the raw numbers tell a story in themselves.

As power negotiations and shifts occur, an open question is whether data and software providers might turn from *implicit* to *explicit* interlopers, which feature their own media coverage and then do challenge journalistic authority, similar to blogs and citizen journalists (Eldridge, 2019). *Fussball.de*, run by the German Football Association, for instance, provide reporting on amateur matches, even though they claim that they "don't call [their coverage] journalism, but rather text generation according to data," as the software cannot "give context" or "judge" matches, and thus "the ma-

chine won't replace journalists." They regard automated content as a service to amateur clubs, which can use the articles on their websites and social media feeds. Despite these claims, their offering of extensive coverage opens up a new dimension of the automated news process. As in the examples above, implicit interlopers may become explicit interlopers even if that was not their original intention. In the case of *fussball.de*, the involvement of interlopers goes even further, as the German Football Association works with a team of software and machine-learning specialists as well as linguists, which demonstrates how an interloper works with other interlopers to provide automated news articles. Data and software providers may also become explicit interlopers. For example, Sportec Solutions and Retresco work on new media formats together, which are supposed to be used for both their customers and themselves. OPTA and Retresco also see other interlopers using automated sports content. Betting companies, for example, may employ historical data not only to calculate their odds, but also to generate stories around them. Thus, *fussball.de* and the other implicit interlopers take an active role in "defin(ing) the place of automated journalism within the larger context of news" (Carlson, 2015, p. 417), demonstrating how interlopers shape this field.

In all these cases, media outlets are cut out of the process. In this new environment, media outlets thus have to clearly establish the added value they give their readers with automation, and how their coverage differs from what interlopers deliver. *Nordbayern Amateure* could be a model for this avenue. They heighten the value of providing news content in large volume by editing every article with quotes and in-depth information, thus using automated articles as a baseline. Thus, they retain journalistic authority while making effective use of the technology. All in all, as data and software providers as well as other implicit interlopers continue to acquire journalistic authority, the power balance between interlopers as mere service providers on the one side and media outlets on the other is shifting. It is not yet known how these developments affect an already shrinking news market, and how interlopers will define their role in news production, even if they might not describe their content as 'journalism.'

As implicit interlopers may become explicit interlopers and take the journalistic stage, this expanded involvement of interlopers may have consequences for all actors in the journalistic news process. This includes the audience, which, as could be seen in this article, is perceived as almost a partner in developing automatically created output. Questions arise about how readers would perceive the interlopers' news-like narratives which take on journalistic authority over match odds and player profiles, especially when these narratives are indistinguishable from journalistic articles. Moreover, it remains to be seen whether audiences care about such a distinction in light of being offered a highly personalised product that news media are often not able to deliver due to person-

nel and budget constraints. I propose that researching this distinction between automatically created articles provided by news outlets and by interlopers is a route that research on audience perceptions of news automation could take. The present works mainly focus on the reception of new outlets' content, and examining interlopers as another message source could shed new light on audiences' perception of both source and message credibility of automated content.

All interviewees except *Sportbuzzer*, which stopped creating automated articles, either have plans for the enhanced use of automation or see the potential for further applications. *Fussball.de* is working on new features, such as putting player profiles into text (e.g., club history, minutes played), programming a skill for Amazon's Alexa, or adding articles for youth leagues. *Beinschuss* aim to experiment with winter sports and further areas such as weather and event calendars. Thus, it remains to be seen how automation will continue to be employed in sports newsrooms, and whether other sports coverage apart from amateur football will be automated; the future direction will largely depend on data availability. For professional football, OPTA and AX Semantics propose using more data sources, such as tracking data gathered from sensors on players' jerseys, to flesh out the reporting. While they acknowledge that privacy considerations may be a concern, AX Semantics say that this kind of data would bring about a "new space of meaning" for sports journalism. But even without innovative data collection methods, also professional football coverage is generally thought to benefit from automation. Unlike in amateur football, the mere coverage of professional football is not an issue, yet "being the first to cover it" (Retresco) could be. Automation could then be used to send out short snippets and direct audience attention to their outlet via push notifications. Internationalisation strategies might also play a role, since some software offers to simultaneously translate the generated articles into other languages. Both software providers mention the possibility of finding new markets, such as "fans who are located in other countries" (AX Semantics). In summary, automation holds considerable future potential, and it remains to be seen how media outlets and interlopers will exploit these opportunities.

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Conflict of Interests

The author declares no conflict of interests.

Supplementary Material

Supplementary material (interview outline) for this article is available online in the format provided by the author (unedited).

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Article

Assistance or Resistance? Evaluating the Intersection of Automated Journalism and Journalistic Role Conceptions

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Abstract

Newsrooms are a social context in which numerous relationships exist and influence news work—be it with other journalists, the audience, and technology. As some of these relations change due to technological innovations, new hybrid contexts—technologies that are interwoven with newsroom values, routines, and socio-cultural experiences—can emerge. One key question is how journalists conceptualise and interact with such technologies, and to what degree they retain (creative) agency in the process. Therefore, this study evaluates the intersection of automated journalism and journalistic role conceptions. Using Hanitzsch's and Vos's circular model of journalistic roles (2017) and Deuze's understanding of journalism as an ideology (2005) as a theoretical framework, this study examines some of the discursive aspects of automated journalism by asking: To what extent are journalistic roles (a) challenged or (b) advanced as a result of automated journalism? Our findings more closely align with the latter, pointing to a strong sense of discursive maintenance of journalists' roles and their core skillset and thus suggesting a high degree of ideological continuity in the face of industrial disruption. It concludes with an agenda for future research and stresses that at times when journalism and automation intersect, the field would benefit from incorporating emerging conceptual frameworks such as human–machine communication.

Issue

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1. Introduction

On 1 February 2019, *The Guardian Australia* published its first news story written by its in-house automated system, ReporterMate. This followed an upward trend observed in journalism since 2014: the rise of 'robo-journalism,' narrative texts generated by computational tools allowing for the partial automation of the news writing process "with limited to no human intervention beyond the initial programming choices" (Carlson, 2015, p. 416) and deployed particularly for data-intensive beats. A prominent example is the *Los Angeles Times's*

website "The Homicide Report," which includes elements of automated journalism to report on the latest crime news across the city (Young & Hermida, 2015). Also in the United States, *Forbes*, *The New York Times*, *The Atlanta Journal-Constitution* and *ProPublica* are known to make use of, or at least experiment with, these types of innovation (Graefe, 2016; Hansen, Roca-Sales, Keegan, & King, 2017). Elsewhere, examples include both the *Berliner Morgenpost* and the *Handelsblatt* newspapers in Germany (Dörr, 2016). Here in particular, a number of private companies have since established themselves as leaders in the field of automated text

generation. One of them, *Retresco*, was awarded the United Nations' World Summit Award in 2017 for its use of artificial intelligence (AI) in the field of natural language generation (NLG). While much has been made of its potential of freeing up journalists for more sophisticated workplace tasks (Graefe, 2016), the introduction of new technologies in journalism has historically been met with a great deal of resistance on behalf of those most affected by them—namely, journalists themselves (Thurman, Dörr, & Kunert, 2017). If the words of Harvard Business School Professor Shoshana Zuboff (1988)—"everything that can be automated will be automated"—are to be believed, what of the social implications for journalists and how they conceive of their roles as automation becomes an integral part of contemporary newsrooms?

A core question emanating from this consideration is the extent to which journalists retain (creative) agency in relation to such new technology, which is gaining agency in the form of AI (Jones, 2019). According to Guzman and Lewis (2020), "much has yet to be learned regarding how people conceptualize and interact with these more advanced technologies within the context of their daily lives" (p. 8). In this regard, this study's main goal is to increase our understanding of how journalists respond to algorithmically led automation processes—and automated journalism in particular—in the newsroom, as well as how they articulate journalism's core ideals as a result of it. Building on Hanitzsch's and Vos's (2017) circular model of journalistic roles and their discursive construction as a theoretical framework, as well as 10 semi-structured interviews with editors and journalists across several German media organisations, this study extends our understanding of how journalistic roles are either (a) challenged or (b) advanced as a result of algorithmically-driven datafication. More specifically, do journalists feel that their performance is enabled or constrained by automated journalism? Thus far, much of the discourse on automated journalism is characterised by a somewhat Manichean stance, suggesting a zero-sum dichotomy of enabler versus constraint. Such a view, however, omits that "new technologies have always been met with overtly optimistic or pessimistic scenarios arguing that the new development will change media content for better or for worse. Automated content creation is no exception" (van Dalen, 2012, p. 654). The rise of automated journalism, therefore, heeds the call for a better understanding of how journalists interact with technology in the context of contemporary newswork (Wu, Tandoc & Salmon, 2019).

As such, we suggest that the introduction of automated journalism into contemporary newsrooms forces a rethink of how journalists conceive of and perceive their roles in light of algorithmically driven datafication. After all, newsrooms are a social arena in which numerous relationships exist and influence newswork— amongst journalists, the audience, and technology in and of itself (Lewis & Westlund, 2015). However, thanks to technological innovations such as automated journalism, these relationships find themselves in a state of flux, leading to hybrid arenas in which novel technologies are interwoven within long-held newsroom values and routines. Building on the work by Wu et al. (2019) on the social implications of newsroom automation as it becomes part of the social arena the newsroom constitutes, we thus ask: Do algorithmically led automation processes in the newsroom lead to a reconfiguration of journalistic role conceptions? In considering these social implications as a guiding logic throughout our study, we also imply that much of the existing research on the intersection of algorithms and journalism emphasises the tangible, *technical shifts* occurring—but it (somewhat inadvertently) omits the *cultural lens* through which these shifts can be observed. As such, our focus moves away from the *object* (the technology itself) and instead considers the *subject(s)* (the journalists) and their associated roles, values and conceptions.

We do so by revisiting Hanitzsch's and Vos's (2017) theoretical framework on journalistic roles and their discursive construction and Deuze's (2005) notion of journalism as a professional ideology by evaluating its intersection with automated journalism. Following this, we add to empirical knowledge by presenting in-depth interviews with editors and journalists across major German news organisations to shine light on the discursive aspects of automated journalism as well as assessing whether their journalistic 'performance' is enabled or constrained as a result of automation. Our findings reveal that journalists see automation as supplementary rather than expendable to their work; automated journalism is perceived as *complimentary to* rather than *competing with* their existing skillset (Neuberger & Nuernbergk, 2010). Their narratives point to a strong sense of discursive maintenance of journalists' roles and their core skillset, thus suggesting a high degree of ideological continuity (Deuze, 2005) in terms of their professional orientation, even if they face industrial disruption.

2. Literature Review: Automated Journalism, Journalistic Roles, and Professional Ideology

Given the relative novelty of the phenomenon of automated journalism, academic research on the subject so far remains limited. However, a small number of previous studies have made first forays in illuminating the issue further, ranging from experimental studies in which journalists were able to gain first-hand experience with the software (Thurman et al., 2017) to studies in which key journalistic staff were asked about their uses of and experiences with the technology. These include Bucher's (2017) study on how the computational is articulated in the newsroom. Drawing on in-depth interviews with Swedish journalists, she finds that the integration of computational processes in the journalists' newswork is something staff think *about* rather than think *with*. Computational processes had yet to be fully

implemented at the time, and the use of software did not replace human journalists but rather supplemented their work. The viability of traditional journalistic labour was thus maintained: Indeed, she finds that "claims about the inferiority of the machine…need to be understood as a discursive strategy used to maintain the distinctiveness and value of journalistic professionalism" (p. 931). This is congruent with previous studies which confirm the viability of traditional journalistic values even when faced with automation (Karlsen & Stavelin, 2014). For the technology to genuinely fulfil its potential in Norwegian newsrooms, "craftsmen with knowledge to build, wield and aim the technology are needed" (p. 45). Retrospective analyses of how automation was gradually introduced into the newsroom over decades further suggest the extent to which journalists mitigate the introduction of increased automation in the newsroom (Linden, 2017). Because automated journalism still is a somewhat small domain to this date—and largely limited to 'elite' and resourceful news organizations—such analyses reject the notion of a possible replaceability of humans by the machine. Instead, journalism understood as an ideology (Deuze, 2005), conveying how journalists attribute their work with meaning, will likely continue to be a mitigating factor to counter automation in the newsroom.

Pioneering research into the phenomenon of automated journalism was conducted by Graefe (2016) in his *Guide to Automated Journalism.* The technology, he argues, offers unprecedented opportunities for producing a large number of articles in different languages in an extremely short space of time, allowing managerial staff to lower production costs while at the same time increasing profit margins. Equally, however, fears are rife that an increase in available articles could lead to information overload, resulting in a lack of orientation in an already 'noisy' digital news environment: "An increasing quantity of available news will further increase people's burden to find news that is most relevant to them" (Graefe, Haim, Haarmann, & Brosius, 2016, p. 12). Concerns also revolve around the fact that automation could lead to the gradual disappearance of newsroom jobs that are characterised by data intensity, such as weather reports and financial news coverage (Carlson, 2015). Furthermore, algorithms cannot fill the gap that would be left by human journalists should the technology indeed lead to a gradual elimination of such rank-and-file roles: Algorithms cannot interrogate data or even establish causality and are therefore "limited in their ability to observe society and to fulfil journalistic tasks, such as orientation and public opinion formation" (Graefe et al., 2016, p. 6). Or, in other words: "Algorithms can provide accounts of *what* is happening, but they cannot explain *why* things are happening" (Haim & Graefe, 2017, p. 1056; emphasis in original). Graefe thus advises journalists to focus their attention on skills that give them a competitive advantage over increased automation, that is, their ability to create in-depth, investigative journalism that would still re-quire journalists to ask probing questions and to apply a healthy amount of skepticism.

Previous studies range from experimental studies of readers' perceptions of automated journalism (Haim & Graefe, 2017) to workshops allowing journalists to experiment with the software themselves (Thurman et al., 2017) or as design partners for AI-based tools in journalism (Gutierrez-Lopez et al., 2019). Some of these involve in-depth interviews with practitioners in the field, a widely used method "to gain insights into the individual experiences, attitudes and views of a select group of professionals working in the area of journalism" (Hermida & Young, 2017, p. 173). However, far less research has thus far uncovered how journalists *themselves* perceive the phenomenon of automated journalism and its impact in the workplace. This, however, is essential in order to better comprehend how the role of journalism is not just understood as a profession, but as an ideology, giving insights into how journalists attribute their labour with meaning (Deuze, 2005) and navigate in an environment characterised by frequent innovations, illuminating, not least, "how these technologies reproduce, embody or alter norms of professional ideology" (Young & Hermida, 2015, p. 384). It further sheds light on what journalists understand their own role to be and the ways in which this understanding gives "meaning to their work…to justify and emphasize the importance of their work to themselves and others" (Hanitzsch & Vos, 2017, p. 115). This is a necessary notion to revisit in a media environment best characterised by significant disruption in an increasingly dense, complex, hybrid, multi-channel, interactive and participatory information environment.

According to Hanitzsch's and Vos's circular model of journalistic roles and their discursive constitution, we consider their proposed roles in light of automation in the newsroom. Four roles have been suggested: *normative ideas* (what journalists *should do* and what society expects of them); *cognitive orientations* (what journalists *want to do*, and how this idealised scenario corresponds to the normative roles expected of them); *professional practice* (what journalists actually *do* and how they execute their work, possibly also in light of real-life workplace constraints); and their *narrated performance* (what journalists say they *should* do, through a process of internal negotiations). Adopting this framework is relevant in the sense that "the discourse of journalistic roles is the central arena where journalistic identity is reproduced and contested; it is the site where actors struggle over the preservation or transformation of journalism's identity" (Hanitzsch & Vos, 2017, p. 129). Precisely how their identity is shaped by automation novelties has received little attention so far, yet, in light of such transformative change, conceptualising the human–machine relationship through the prism of journalists' discursive construction of their identity addresses an important gap evident in existing scholarship. It is precisely for this reason that in-depth interviews were particularly well-suited as a methodological approach for this study, as they help

us "understand the social actor's experience, knowledge and worldviews" (Lindlof & Taylor, 2010, p. 173).

In addition, our work also considers how journalists negotiate their professional ideology (Deuze, 2005) in the face of automation, specifically how journalists constitute their work as meaningful to themselves and others in a discursive construction (Hanitzsch & Vos, 2017). According to Deuze (2005), these include five ideal-typical values: *public service* (journalists as disseminators of information and 'watchdogs' over society); *objectivity* (journalists adopting an impartial and neutral stance in their reporting); *autonomy* (journalists as free and independent actors); *immediacy* (journalists' instantaneous working practices); and *ethics* (journalists' adherence to a code of conduct). It is worth pointing out that these two theoretical concepts are herein invoked for their general focus on how journalists articulate their professional purpose, rather than for their elaboration on specific roles and values, and automation's relationship to those. Still, studying these normative ideals in-depth allowed us to understand "how journalists from all walks of their professional life negotiate the core values [through which] one can see the occupational ideology of journalism at work" (p. 458). But are these core values subject to change with respect to the rise of human–machine communication? Or do we, perhaps, see a degree of ideological continuation in the face of industrial disruption? In revisiting his earlier work in light of profound industry transformations, Deuze (2019) suggests the latter, namely:

A commitment to the ideology of journalism [that] remains firmly in place.....Their loyalty to journalism as an ideal remained intact.....Journalism [as an ideology] remains the same, yet the conditions under which it is practised have not only changed considerably, they are in permanent flux. (p. 2)

As such, this study is centred on the future of journalistic labour (Carlson, 2015): We consider both the extent to which journalistic roles and the discursive constitution of their identity (Hanitzsch & Vos, 2017) as well as journalists' professional ideology (Deuze, 2005, 2019) are (a) challenged or (b) advanced as a result of introducing a—potentially disruptive—technology in the newsroom, particularly in light of journalists' expressed sense of autonomy. Are they still the sole holders of said autonomy at a time when a new entrant—technology itself—becomes embedded into the social fabric of the newsroom? While much has been made of its utility to assist editorial newswork—be it its data-scraping prowess or at-scale production capacity—existing research highlights the exclusivity of human agency in journalistic articulations about their professional identity. In clearly demarcating human from algorithmic storytelling, journalists stressed elements such as creativity and critical thinking to discursively maintain the centrality of their professional autonomy (Carlson, 2015). As such,

"reconsiderations of what makes human-produced news unique suggest that journalistic authority derives from something more than delivering objective information about the world; it thrives on dissecting the drama of public life and the emotionality of quality news writing" (Carlson, 2015, p. 428). The fact that algorithmic judgement in newsrooms has now been institutionalized (Thurman, 2019) "compels greater sensitivity to the distinctiveness of professional journalistic judgment and algorithmic decision-making. Most expressly, journalists need to forge new arguments for their cultural authority based on their active suitability to render thoughtful judgments" (Carlson, 2018, p. 1768).

In sum, we suggest that the introduction of automated journalism branches out into three interrelated consequences: (1) the increasing *commodification* of journalism (as a result of automated articles being produced at-scale); (2) its enhanced *approximation* to resemble human work (as the technology continues to improve); and (3) its gradual *normalisation* (as use of and acceptance for it start to take hold). This, in turn, has a direct and tangible impact on said autonomy, which may be compromised and thus stands in stark contrast to journalists "espousing their irreplaceability" (Carlson, 2015, p. 425). In-depth interviews with professionals in the field allowed us to evaluate the intersection of automated journalism and journalists' long-held professional ideology accordingly.

3. Method

As mentioned, the still relatively novel phenomenon of automated journalism finds particular applicability in special interest outlets covering beats prone to automation. In Germany, for example, the local newspaper *Berliner Morgenpost* and the *Handelsblatt* have piloted the software, particularly for financial news and stock exchange reports. That said, however, it is important to note that many journalistic clients of NLG service providers operate under strict contractual nondisclosure agreements, possibly a result of not necessarily wanting to be associated with a technical novelty that, at least in some parts of the industry, is still looked at with a hint of skepticism (Graefe, 2016). As a result, with the exception of Dörr's (2016) study, which offers an overview of service providers of NLG across special interest journalistic clients, reliable data on either existing usage or possible future implementation of the software across German media organisations are virtually non-existent. Given the technology's widely predicted uptake in the years to come, and Graefe's (2016) outlook that "the quality of automated news will likely continue to improve, both in terms of readability and the ability to generate insights that go beyond the simple recitation of facts" (p. 40), this study deliberately set out to fill the gap left by Dörr's (2016) study and its focus on special interest outlets. Instead, it focussed on staff working for major German news organisations who

might not (yet) make use of the technology in the actual production of journalistic work, but whose organisations have in the past deployed algorithms to assist editorial newswork in 'big data' projects. With this rationale in mind, four news organisations were considered to be particularly relevant to this sample: *Spiegel Online*, known for its automated rating of a soccer player's performance in its Spielerindex application (Montazeri & Kolbinger, 2017); *Süddeutsche Zeitung*, known for its pioneering use of algorithms to sift through the Panama Papers files; *Frankfurter Allgemeine Zeitung*, known for its automated topic pages powered by Retresco (2017); and *Zeit Online* with its Street Names project, an interactive tool which looks for patterns in the distribution of street names across Germany. The latter project relied on data gathered by service provider Geofabrik and was nominated for the prestigious Grimme Online Award in 2018, an annual prize which honours particularly innovative journalistic work in Germany (Zeit Online, 2018). Another award-winning case in Germany is the Feinstaubradar (fine dust radar) project by the *Stuttgarter Zeitung*, which cooperates with locally based AX Semantics to produce daily, automated reports on the city's high concentration of fine dust in the atmosphere (*Stuttgarter Zeitung*, 2018). Unfortunately, however, interviews with newsroom staff working at the *Stuttgarter Zeitung* could not be realised due to the submission deadline of this paper. In addition to the outlets mentioned in Dörr's (2016) study, these are prominent examples which have attracted ample media coverage in Germany thanks to their inventive use of algorithms to assist contemporary editorial newswork.

In a next step, potential interviewees who could be questioned on perceptions of and reactions to the phenomenon of automated journalism as well as its use in relation to journalism's professional ideology had to be identified. To do so, the researchers subscribed to the Cision Media Database, which hosts worldwide contact details of journalists working for different media organisations across the globe. Two different groups of newsroom staff were identified as being particularly well-suited to this study: first, journalists working in domains such as business and finance, weather and sports cover-

age more generally; second, newsroom staff with some editorial oversight were selected from the database, so as to accumulate rich insights from various hierarchical levels in the newsroom including rank-and-file staff as well as senior management. The contact details of newsroom staff who best fitted that description were then exported from the database. 73 editors and journalists were contacted by email in the first instance, and, if necessary, a second time in a follow-up email. These contact requests resulted in a total of $n = 10$ positive replies (response rate: 13.7%). All interviews were conducted in January 2018 via telephone or Skype, with the exception of one interview whose responses were provided via email. Despite the less favourable, asynchronous properties of an email interview—which is void of social interaction and does not allow the interviewer to ask immediate follow-up questions—in this particular instance, they still yielded rich and helpful insights.

With each interview lasting an average of 30 minutes, responses were subsequently transcribed verbatim and translated from German into English. Participants were assured that interviews would be conducted on the basis of anonymity, that is, instead of revealing their identity, respondents were assigned alphabetical codes as per Table 1. Following on from the transcription, the collected interview data was analysed qualitatively to uncover emerging narrative patterns, allowing the researcher to "draw together the data collected and structure them in such a way as to make ready for analysis" (Wilkinson & Birmingham, 2003, p. 63). The journalists' narratives were written up, compared with each other and clustered into themes so as to "weave in a narrative…interpolated with illustrative quotes" (Gillham, 2000, p. 74). Overall, the findings point to the ways in which journalists' roles were either (a) challenged or (b) advanced as a result of automation novelties, and ways in which these impact on possible reconsiderations of their professional ideology.

Following a first round of interviews with newsroom staff working for the four selected organisations, two supplementary interviews with a reporter and a freelance journalist known as experts in the field were conducted which helped substantiate the results emanating from

Table 1. Sample of interviewees including media outlet and position held.

Code	Media Outlet	Position
A	*Spiegel Online*	Data Journalist
B	*Netzpolitik*	Reporter
C	*Zeit Online*	Editor in executive position
D	*Süddeutsche Zeitung*	Editor in executive position
E	*Süddeutsche Zeitung*	Editor in executive position
F	*Freelance*	Data Journalist
G	*Süddeutsche Zeitung*	Editor in executive position
H	*Frankfurter Allgemeine Zeitung*	Business Journalist
I	*Frankfurter Allgemeine Zeitung*	Sports Journalist
J	*Süddeutsche Zeitung*	Data Journalist

the first round of conversations. Our core research question was:

> RQ: To what extent are journalistic roles (a) challenged or (b) advanced as a result of automated journalism?

4. Findings

The purpose of this study was to aid our understanding of how journalistic roles are either (a) challenged or (b) advanced as a result of algorithmically driven datafication. More specifically, do journalists feel that their performance is enabled or constrained by automated journalism? We hypothesised that—given its ability to lower production costs while at the same time increase profit margins—editorial staff in managerial positions would be positive towards its increasing introduction, while less senior reporters would voice concerns in relation to possible replacement fears (Bucher, 2017) by the technology, particularly in the years to come as it is expected to improve its various affordances (Graefe, 2016).

4.1. Man versus Machine?

The results do not support this hypothesis. With the exception of one journalist (I), interviewees overall dismissed the idea that professional roles currently performed by human journalists would need to give way to technology in the future. Crucially, their responses give credence to what was previously described as "journalism as an ideology" (Deuze, 2005), that is, how journalists give meaning to and legitimise their professional roles. Indeed, respondents were eager to defend their roles in the face of automation—roles which, to their mind, would exclusively align with the capabilities of human journalists: indeed, it was especially striking how frequently interviewees used terms such as "creativity" (I, C, H), "context" (A, D) and "uniqueness" (I, E) in their responses.

Their overall perception and understanding of journalism predominantly manifested itself as an art or a craft rather than "some manual task on an assembly belt" (H). That special craft could, according to the interviewees, best be described by linguistic eloquence, stylistic nuance and a general need to not merely convey facts objectively, but to contextualise them, that is, to take readers by the hand and help understand the deeper meanings, possible consequences and wider (societal) significance of the factual information they are consuming. They also stressed the need for a human editor to double-check and to validate accounts of sports or financial news coverage—both beats particularly prone to increasing automation in the future. As one editor for the *Süddeutsche Zeitung* remarked:

> If there is even just a grain of assessment or evaluation in the text, then I do believe it is absolutely crucial for a human editor to thoroughly double-check

that….[But] I am not worried that computers will replace human editors in the future—because I do not believe that that sort of assessment or evaluation can possibly be implemented in automatically-generated content just yet. (D)

Their colleague at *Spiegel Online* concurred: "I simply cannot see this [automated journalism] to go beyond purely descriptive coverage. As soon as it comes to interpreting events and contextualising them, I do not believe that algorithms could ever possibly fulfil that task'' (A). Beyond the aforementioned linguistic eloquence and stylistic nuance, interviewees further believed in the narrative function of journalism, which is to pursue a red line that provides background information and adds context. In this, they see an added value function that purely fact-based re-narration of events would not be able to accomplish. In the words of a data journalist at the *Süddeutsche Zeitung*:

> Generally, I am very positive about this [automated journalism] [and] I am not worried about being replaced by it [the software]. You will always have to speak to protagonists and experts, and there will always need to be someone who binds it all together and puts it into a narrative. (J)

This was mirrored by a colleague:

> Journalism is far too much a creative industry for there to be people who would only want to consume fact-based news….I'm quite optimistic when it comes to technology. Because technology brings us more than it hurts us. And the same applies to automated journalism. (H)

4.2. Supplementary or Expendable?

Crucially, not only was there general optimism towards technological innovation, but there was broad agreement among both senior editors and reporters that their work would not be *replaced* by automated journalism but rather be *supplemented* by it—a finding which aligns with previous research on the issue (Bucher, 2017). Respondents were upbeat about the various opportunities automated journalism could bring to the newsroom—which was, first and foremost, an ability to free them from "annoying duties" (A) and thereby allow them to devote themselves to more analytically rigorous tasks. As one journalist put it:

> I definitely see a chance in this [automated journalism]. Because it won't replace the work of editors but supplement it; it can complement it even….And so, in the future, editors will be freed from such [basic] work, meaning that they'll have more time for deeper investigations that algorithms themselves cannot deliver. (A)

The data journalist working for *Zeit Online* was of the same opinion: he, too, believed that the basic tasks of rank-and-file journalists could give way to increasing automation without reporters having to be overly concerned about being 'replaced' by the machine. To his mind, the journalism industry would transform in a way that would allow reporters to pursue "more exciting narratives" (C, J) while somewhat simplistic fact-based reporting would be performed by algorithms. He explained that:

> There are no alarm bells ringing for me that this [automated journalism] would make human editors replaceable. I would rather think that if robots complete very basic bread-and-butter tasks that resources would be freed up in the newsroom….I don't see the whole industry in danger just because two editors leave because robots do that sort of thing now. (C)

This argument was supported across the board, with automated journalism generally seen as a "positive development" (F). Notwithstanding some of the economic imperatives journalism as an industry faces, which may constrain the extent to which journalists are able to enact some their roles (Hanitzsch & Vos, 2017), such narration underscores the ideal of autonomy journalists pursue, which places them as free and independent actors in their newswork (Deuze, 2005)—an ideal they see as remaining intact in the space of automated journalism. A notable exception was the sports journalist working at the *Frankfurter Allgemeine Zeitung*, who regarded this as a somewhat naïve fallacy pursued by those who are generally favourable towards technological innovation. He said: "I tend to be rather worried about it. I don't know if this whole claim, that it would be free up resources for in-depth investigations, isn't perhaps somewhat self-deceiving'' (I).

4.3. Professional Ideology—Revisited?

As mentioned before, previous studies indicated that computational processes in journalism are something journalists passively think *about* rather than actively think *with*, thereby re-affirming, once again, the supplementary rather than the expendable function of its specific subset of automated journalism (Bucher, 2017). Indeed, the interviewees' reflections on automated journalism spurred on reflections about the deeper meaning journalists attribute their work with, exposing, inter alia, the normative and ideologically driven sense-making mechanisms described earlier (Deuze, 2005). These were, as it happens, diametrically opposed to the capabilities of automated journalism. One interviewee went as far as to suggest that "automated journalism misses the basic journalistic function…to contextualise information properly" (E). He continued, "to simply convey the facts is not attractive for the reader…[But] what will bring them to our product is how these facts are con-

textualised and how they are presented in context within a written format."

In stressing the exclusivity of the journalism profession, his colleague at *Zeit Online* concurred: "Journalism has to be unique, always. Pure information that is merely conveyed as fact is not exactly spectacular" (C). His colleague, the sports journalist at *Frankfurter Allgemeine Zeitung*, went a step further and saw little value in automated journalism altogether. He stressed his preference towards content produced by humans—for the exact same reason of it being a "unique" piece of work "crafted" by an individual. In his words, "I want something that is uniquely created by journalists. I don't even need the most objective, factual or data-heavy content. The reason I like consuming journalism…is because I think these are people who know their stuff" (I). The importance of human intervention in that process was also evident in that "the whole point of journalism is that human beings observe what is happening in the world out there and how they therefore describe, assess and contextualize that" (I).

4.4. What Is Journalism?

It is because journalists did not feel threatened by such technological innovation and were equally unconcerned about possible future replacement by the machine that interviewees saw their journalistic 'mission' not just in the need to report the data, but to extract its deeper meaning and consequences (C, D) as well as an ability to approach and interact with informants to uncover newsworthy clues for further investigation (A, H). In other words, they urged fellow journalists to focus on skills that human journalists embody (Thurman et al., 2017). One editor at *Süddeutsche Zeitung*, for example, was convinced that what was increasingly required was "that special journalistic impulse" which included "curiosity about what the story behind the data is…[Otherwise] it is hard to convey your message which will make the story interesting and readable in the first place" (D). A colleague agreed with this sentiment when he stated that "as a journalist, you should be able to understand what sort of information can be hidden away in data and what patterns you should keep an eye out for" (C).

In addition, interviewees were eager to stress a need for the remnants of traditional research skills and journalistic practice, that is, to meet informants, speak to them and to experience events at the scene through one's own lens. Despite his data-intensive professional background, a data journalist at *Spiegel Online* even prioritised such traditional research skills over the data scraping capabilities a journalist in his field should possess—capabilities which would provide nothing more than some degree of 'added value.' To his mind, "with data research, what follows is always traditional research. I need to speak to people and let those involved have a say. That's the first bit. And what comes on top of that are technical skills'' (A). One interviewee put it even more bluntly

when he said that, "without the willingness to meet new people and to approach them directly, [and] without curiosity, nothing is possible" (H). Conceiving of their roles in this manner underscores journalists' normative and internalised cognitive role orientations in contributing to the proper workings of democracy (Hanitzsch & Vos, 2017). This found particular expression in the public service role (Deuze, 2005) journalists attribute their work with, which includes a unity of purpose to act as servants for the public and as 'watchdogs' over society. Given the journalists' expressed belief of freed-up resources to devote to in-depth investigations in the space of automated journalism, this ideal may not only remain intact, but could in fact be strengthened.

4.5. Assistance or Resistance?

Contrary to initial hypotheses, the interviewees' responses indicated a general enthusiasm and positivity towards automated journalism irrespective of professional hierarchy, primarily on the grounds that the technology could free up resources to allow for more in-depth investigations requiring the skills of human journalists. Rather than replacing their work, journalists were upbeat about the supplementary toolkit they would receive as a result of increasing automation in the newsroom. One journalist stressed his expectation for strengthened future collaborations between reporters and technical staff (F), as was the case in the much-referenced Panama Papers investigation revealed by the *Süddeutsche Zeitung*.

One example of how automation can aid the work of rank-and-file journalists was mentioned by a data journalist at *Spiegel Online*. Referencing their coverage of soccer matches, he explained their collaboration with sports analytics company Opta, which the provides the newsroom with large data sets after each match. The data contains a host of parameters which would then be paired with their in-house technology SPIX (Spielerindex), which helps rate each player based on their performance. This would be passed on the reporter who would then "put text around it" (A). He further stressed the general suitability of sports coverage to be aided by computational processes, "just because so much data is available" and was expecting such an uptake in the future.

His colleague at *Zeit Online* saw automation to be particularly applicable to automatic alerts in the future, that is, notifying journalists of sudden events, such as earthquakes, via push alerts on their mobile devices or email notifications on their desktop computers (C). Another interviewee expected automated journalism to be applicable to smaller, local newspapers, while he was expecting larger organisations to experiment with personalisation of content rather than full automation (B).

5. Conclusion

The interviewees' various accounts provide us with insights into whether media practitioners in German news-

rooms feel that their roles are either (a) challenged or (b) advanced as a result of automated journalism. Contrary to somewhat inflated man-versus-machine narratives suggesting the gradual replaceability of human journalists by 'robo-reporters,' newsroom staff sensed that the technology's opportunities would indeed advance their roles. As such, they rejected the idea of feeling threatened by technological innovation—and with the exception of one sports journalist, this was the case across the board, irrespective of the level of hierarchy the individual had attained in the newsroom. In fact, quite the opposite was the case: Both editors and journalists were upbeat about the opportunities automated journalism could bring with itself—first and foremost, its ability to free themselves from the daily grind of purely factual reporting and to instead devote their resources to profound, in-depth investigations requiring the skills that human journalists embody. As a result, this study is in agreement with previous research on how the computational is shaping journalistic practice and broader role understandings: In this context, interviewees felt that automated journalism would *supplement* rather than *replace* their work (Bucher, 2017), leading them to see innovative approaches to the journalism domain as *complementary* rather than *competing* (Neuberger & Nuernbergk, 2010). While being generally positive towards technological innovation, it was only in their own, human work that they genuinely sensed a degree of 'added value.' This found expression in journalists' articulations of their profession as a creative process, used as discursive means to demarcate their human skillset from the affordances automation would bring— not just to the journalism domain, but in creative and artisanal industries as a whole (Linden, 2017). Interestingly, this finding also points to widespread shifts as evidenced in decades of newsroom ethnographies: Observations of the 1970s have indicated a level of conformity, institutionalism and rigidity to *constrain* journalistic creativity to the point where it was linked to assembly-line work (Gans, 1979; Tuchman, 1978)—a metaphor used by one of our own interviewees to differentiate his distinct professional practice. Remarkably though, an assembly-line perspective of newswork with its focus on increased efficiency is gaining traction as of late: Although being more flexible, adaptable, and scalable in the composition of its elements, so called structured and 'atomised' forms of journalism are becoming more common (Jones & Jones, 2019).

Most strikingly, however, conversations about automated journalism have led journalists to rigorously defend their own work—or indeed, "craft," as many referred to it—in the face of automation. Through their narrated performance, a process of normalisation takes place, which in turn reinforces their normative roles (Hanitzsch & Vos, 2017). Once again, it is worth bearing in mind that our study did not examine specific roles, but instead looked more generally at the articulation of these roles as a means of maintaining professional ideol-

ogy. That said, reflections on what journalism is becoming as a result of digitisation has not only led journalists to preserve their normative, professional ideology: Indeed, it has led them to stress the normative foundations upon which traditional definitions of journalism are built. These included, but were not limited, to: journalism as a creative process; journalism as a uniquely individual craft; as well as the need to add background and context in order for recipients to contextualise information accordingly. They also referenced journalism's core ideals of public service and autonomy (Deuze, 2005) and continued to position themselves as authoritative actors in the space of automated journalism. Providing context, orientation and interpretation were referenced as (self-serving) means to suggest that journalistic authority far extends a dogged pursuit of factuality; in fact, the former were constructed as superior traits under which journalistic storytelling would genuinely thrive (Carlson, 2015). In contrasting these human capabilities with the affordances of the technology, one of the most telling accounts was voiced by one editor when he asked: "Can journalism even be automated to begin with? I wonder if that is not a contradiction in its own right" (E).

Such considerations provide fertile ground for future research. For example, does an expansion of automated journalism genuinely lead to an uptake of investigative reporting as a result of freed-up resources, as voiced by so many journalists? Or is a healthy dose of skepticism, such as expressed by one journalist who felt the idea was somewhat "self-deceiving" (I), perhaps more reflective of reality? Indeed, should we take journalists' assertions that their autonomy and value are aided and not undermined by automation at face value, or should we perhaps rather interpret these as somewhat self-serving rhetorical defences of their own, professional worth? Longitudinal studies would help to genuinely uncover this development over time, giving insights into whether the predicted, positive shift resulting from a gradual expansion of automated journalism is valid and, indeed, justified. Such research into the implementation of automated journalism over time would also help address this exploratory study's main limitations: first, its set-up as a pilot means that the findings are indicative; a larger research population would represent a wider cross-section of both editors and journalists alike and, as such, result in more generalizable patterns as the technology continues to be implemented in the newsroom. Second, our exclusive reliance on in-depth interviews needs to be addressed: The research interview as a form of metajournalistic discourse, which entails performative aspects of journalists defending their own value when taken-for-granted practices are suddenly contested, "spurs efforts to define appropriate practices while dispelling deviant or outsider actions" (Carlson, 2015, p. 352). As such, our approach has limited methodological scope as it is based on self-reported data, which has the potential to generate socially desirable responses, and, thus, skew on-the-ground realities. Third, while the composition of the

sample deliberately sought to supplement Dörr's (2016) study by focusing on mainstream media, it means that this particular set of actors may suffer from certain structural influences or biases that may not apply in other contexts: Indeed, our interviewees may be more receptive to automation's role and more confident in their own autonomy due to the fact that they deploy automation in a way that preserves their own authorship and strong interpretative role—that is, for algorithms to assist editorial newswork in 'big data' projects instead of making use of its narrative affordances. Finally, factorial variance is worth bearing in mind when interpreting the results: European newsrooms are less centralised than their Anglo-American counterparts, resulting in a journalistic tradition less clearly separating between facts and comments—a distinction more clearly pronounced in American journalism. It is thus important to embed these findings in the associated media system and journalistic culture in which they are located to better understand how contextual factors play out in practice (Esser, 1999).

Overall, our findings run counter to—somewhat understandable—expectations that journalists would *resist* the rise of automated journalism; instead, our findings suggest that it can *assist* journalists in their daily news work and enable them to devote more attention to sophisticated workplace tasks that do still very much require the skills of human journalists. This also aligns with the results of a major report by the London School of Economics on AI in journalism, which found that "these technologies will augment the newsrooms and save valuable resources to be directed towards serious issues that require the attention of journalists" (Beckett, 2019, p. 53). Thus, while the 'replaceability' narrative comes close to a "dystopian moral panic" (Beckett, 2019, p. 53), the 'human touch' in journalism still comes at a premium—as, once again, confirmed by our interviewees, who discursively retained the core ideals of their professional ideology. This underlines "the centrality of human agency in technological innovation" (Milosavljević & Vobič, 2019, p. 1113).

We suggest that future studies investigating the rise of algorithms in journalism would benefit from broadening and diversifying their theoretical and methodological scope in order to better cater to the transforming nature of the interplay between journalists and technology in much of contemporary journalism. While many of the prominent theoretical frameworks in journalism studies are rooted in the sociology discipline—such as Bourdieu's field theory (1984)—and based on qualitative interview data—as indeed this study does—moving forward, we suggest that in order to cater to the sociotechnical rise in journalism studies (Lewis & Westlund, 2015), future studies may benefit from drawing even more on the emerging sub-discipline of human–machine communication (Lewis, Guzman, & Schmidt, 2019) to fully grasp the quantitative turn (Coddington, 2015) in much of contemporary journalism, thus building our understanding of "not only 'who' does journalism, but also 'what' does

journalism, and that 'what' includes technical artefacts and algorithms" (Diakopoulos, 2019, p. 36). We envisage a future hybrid state in which technological innovations gradually become *embedded* and *interwoven* in the fabric of the social arena the newsroom constitutes; as such, one of journalism's core ideals—autonomy—will have to be shared.

Amidst such industry upheaval, what is, indeed, certain is that "everything that can be automated will be automated," to pick up on the words of former Harvard Business School Professor Shoshana Zuboff (1988) again. Given its various affordances, the technology is likely here to stay. It is widely acknowledged that with further improvements in the readability of computer-generated articles, future uptakes of the technology are to be expected (Graefe, 2016). Equally, however, with the large number of articles automated journalism can produce in a relatively short space of time, concerns over possible information overload as a result of an increased quantity of available articles are rife. In the words of one journalist, "at a time when news itself is extremely important'' (J), he was looking forward to a time when readers would "orient themselves back to legacy organisations that help make sense of it all." The recent rise of digital subscriptions to *The New York Times* lend strong support to that view.

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Conflict of Interests

The authors declare no conflict of interests.

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Article

Negotiated Autonomy: The Role of Social Media Algorithms in Editorial Decision Making

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Abstract

Social media platforms have increasingly become an important way for news organizations to distribute content to their audiences. As news organizations relinquish control over distribution, they may feel the need to optimize their content to align with platform logics to ensure economic sustainability. However, the opaque and often proprietary nature of platform algorithms makes it hard for news organizations to truly know what kinds of content are preferred and will perform well. Invoking the concept of algorithmic 'folk theories,' this article presents a study of in-depth, semi-structured interviews with 18 U.S.-based news journalists and editors to understand how they make sense of social media algorithms, and to what extent this influences editorial decision making. Our findings suggest that while journalists' understandings of platform algorithms create new considerations for gatekeeping practices, the extent to which it influences those practices is often negotiated against traditional journalistic conceptions of newsworthiness and journalistic autonomy.

Issue

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1. Introduction

On January 11th, 2018, Facebook co-Founder and CEO Mark Zuckerberg announced that the company would change its newsfeed algorithm to feature more posts from close friends and family and fewer posts from public brands and media. In the press release accompanying Zuckerberg's announcement, Adam Mosseri, Facebook's Head of News at the time, gestured to the implications of these changes for news and media brands writing:

> As we make these updates, Pages may see their reach, video watch time and referral traffic decrease. The impact will vary from Page to Page, driven by factors including the type of content they produce and how people interact with it. (Mosseri, 2018)

The announcement sent shockwaves through newsrooms that relied on the social media platform as a way to distribute content to audiences, highlighting the complexity and precarity of using third party platforms as a main avenue for news distribution (Zantal-Wiener, 2019).

In order to survive in a competitive market, news organizations may feel the need to optimize their content to fit with the logic of social media platforms' distribution algorithms in ways that potentially conflict with normative principles of journalism. This study seeks to elaborate how the editorial practices of gatekeeping and news selection are influenced by journalists' understandings of social media distribution algorithms. While journalism scholars have previously considered this question on a theoretical level (e.g., Caplan & boyd, 2018; Poell

& van Dijck, 2014), this research takes an empirical approach, conducting 18 in-depth, semi-structured interviews with current newsroom professionals to explicate: 1) How they make sense of the proprietary algorithms that power social media platforms and 2) In what ways they perceive these understandings to influence their decision-making process when selecting news items for coverage. Our findings suggest that journalists understand social media distribution algorithms as filters that decide whether or not their audiences see their content based on a variety of factors, including but not limited to engagement or engage-ability of content, publisher size, payment, and political ideology. Further, our findings indicate that while journalists' understandings of how these platform algorithms function has become a new consideration in gatekeeping practices, the extent to which these algorithmic understandings influence their gatekeeping practices is often negotiated against traditional journalistic conceptions of newsworthiness and journalistic autonomy.

2. Literature Review

Gatekeeping theory was first developed by Kurt Lewin (1947) as a way to explain the forces that impact food consumption. The concept was introduced into communications studies by David Manning White (1950) in his study of the various forces that influenced small-town newspaper editor Mr. Gates' decisions on whether or not to turn an event on the wire service into a news item. White concluded that gatekeeping in journalism was highly subjective, based on the editor's personal preferences and valuation of events (White, 1950). Subsequent studies challenged White's conclusions, arguing that an individual editor's subjectivity was often influenced by the larger structural and organizational constraints of the newsrooms and corporations for which they worked (Gieber, 1956; McNelly, 1959; Shoemaker & Vos, 2009). Shoemaker and Reese (2014) developed a five-level hierarchical model for thinking about how media content is shaped, in which they argued that media content is influenced by individual workers, routines, organizational structures, social institutions surrounding media organizations, and ideological hegemony.

The basis for determining what does and does not become news is predicated on whether an occurrence meets a certain standard of newsworthiness (Shoemaker & Vos, 2009). Several studies have evaluated news output as a means of determining what kinds of content are considered newsworthy, finding that various news values are considered, such as: timeliness, geographic location and proximity to audience, sensationalism, extreme valence, novelty, celebrity, sensationalism, and controversy (Galtung & Ruge, 1965; Harcup & O'Neill, 2001, 2017).

Recent scholarship has reconsidered these traditional understandings of gatekeeping and newsworthiness in the age of digital media (Heinderyckx & Vos,

2016). Traditional practices of gatekeeping were constructed in an age where news reporters and editors had little to no direct contact with their audiences, and decisions were based on normative assumptions about the role of journalism in society (Tandoc & Vos, 2016). However, the increased use of the web for news distribution has given readers new opportunities to exert influence in the gatekeeping process. Not only can news readers directly amplify certain stories online after publication (Singer, 2014), but analytic tools allow their news consumption habits to be tracked and fed back into professional gatekeeping decisions and determinations of newsworthiness (Anderson, 2011; Tandoc, 2014; Vu, 2014).

Social media platforms have also come to play an increasingly important role in shaping gatekeeping practices (Bell & Owen, 2017; Shearer & Grieco, 2019) and determining what news stories actually reach audiences post-publication (Hermida, 2020; Thorson & Wells, 2016). Tandoc and Vos (2016) argue that the use of social media by newsrooms renegotiates traditional understandings of journalistic autonomy, as journalists increasingly look to audiences to assess and reaffirm a story's newsworthiness. Further, other scholars have suggested that shareability, the likelihood that a story will be shared or commented on via social media, and whether or not a topic is trending on social media, have become new metrics for assessing newsworthiness (Harcup & O'Neill, 2017; Welbers & Opgenhaffen, 2018).

Social media's influence on editorial decision making is implicitly linked to journalists' attempts to understand and navigate the private and proprietary algorithms on which these platforms are built. An algorithm, broadly, is a series of encoded procedures or rules that translates information input to solve a problem or achieve a desired information output (Knuth, 1968). These systems assert both epistemological and ideological power through patterns of inclusion, prioritization, filtering, classification, and association (Diakopoulos, 2019; Gillespie, 2014). When news editors and reporters incorporate ideas of social media success into their gatekeeping processes, these power dynamics between the platform's imperatives and news organizations, as platform users, may manifest themselves in the news production process. Caplan and boyd (2018) suggest that algorithmically-driven technologies such as social media platforms and search engines structure the industries that use them through isomorphism; as news organizations become increasingly dependent on these platforms to reach their audiences what these platforms consider relevant or newsworthy may begin to structure what newsrooms see as newsworthy. Similarly, Vos and Russell (2019) argue that through social and search platforms Silicon Valley, as an institution, asserts regulatory and normative pressures on gatekeeping by structuring understandings of newsworthiness through algorithms and the ideological imperatives beneath them. In this way, the unique decoupling of news production and distribu-

tion facilitated by social media platforms has the potential to threaten normative understandings of newsworthiness that may come into tension with more algorithmically driven understandings (Napoli, 2019).

Recent theoretical models of digital gatekeeping have attempted to tease out how algorithms may factor into modern gatekeeping practices. While not all of these models specifically consider the role of platform algorithms in shaping how journalists understand newsworthiness (Thorson & Wells, 2016; Wallace, 2018), those models that do, often argue that gatekeeping norms are increasingly oriented to what news is popular on these platforms (Heinderyckx & Vos, 2016; Poell & van Dijck, 2014) and journalistic conceptions of these algorithmic filters may further mediate the production of news, even prior to actual distribution on platforms (Napoli, 2019).

Teasing this out is often made difficult by the opaque and often proprietary nature of these algorithms (Diakopoulos, 2019). Thus, to understand how algorithmically-driven platforms may shape editorial decisions in modern newsrooms, this study employs a concept which previous scholars have termed algorithmic 'folk theories' (Bucher, 2017; DeVito, Birnholtz, Hancock, French, & Liu, 2018; DeVito, Gergel, & Birnholtz, 2017; Eslami et al., 2016). Eslami et al. (2016) argue that since users of these platforms are unable to truly know how these platforms function, they develop 'folk theories' as a way to conceptualize, understand, and navigate their behavior on these platforms. These 'folk theories' are key in shaping how users interact with algorithmically-driven platforms (Bucher, 2017; Eslami et al., 2015). These informal beliefs do not act as a measure of accuracy, but rather as a metric against which researchers can evaluate how non-authoritative understandings guide users' behaviors through these systems in ways that may differ from the actual technological functions these users seek to understand (Eslami et al., 2016; French & Hancock, 2017). DeVito et al. (2018) found that these 'folk theories' can be drawn from a diverse set of information sources including both endogenous information, such a individuals' own experiences on the platform and platform features, and exogenous information, such as information gained through press and conversations within social and familial networks.

While algorithmic 'folk theories' have been looked at in a variety of platform and computer-mediated contexts, to our knowledge they have yet to be applied specifically to the field of journalism. Unlike everyday social media platform users, journalism professionals may gain additional insight into how platform algorithms function through the explicit use of social media analytic tools, yet they can still never truly know if these understandings are accurate due to the proprietary and opaque nature of these algorithms. Thus, their understandings of the algorithm are still non-authoritative and are not necessarily congruent with the actual technological systems on which they are based, fitting within the definition of 'folk theories.' This study investigates what 'folk

theories' journalists use to understand how social media distribution algorithms function and how they may or may not use these understandings to guide their behavior in optimizing their content for success on these platforms. Drawing on hierarchical understandings of gatekeeping this article also aims to understand how algorithmic 'folk theories' may impact gatekeeping at different levels (Shoemaker & Reese, 2014). Thus, the main research questions posed by this project are:

RQ1: What algorithmic 'folk theories' permeate journalistic practices?

RQ2: How and to what extent do journalists perceive these algorithmic 'folk theories' to influence their editorial decision making and gatekeeping practices at various levels?

3. Methods

To answer our research questions, we conducted qualitative, semi-structured interviews with professional journalists across a range of U.S.-based news organizations.

3.1. Recruitment

Potential interviewees were recruited using three main strategies. First, we searched the professional networking site, LinkedIn, using a series of keywords for jobs relating to news gatekeeping including: 'editor,' 'editorial,' 'editorial producer,' 'booking producer,' 'social media editor,' 'audience engagement editor,' 'analytics editor,' and 'content strategist.' Initial keywords were based on past literature on gatekeeping, and were iteratively expanded based upon the jobs returned in searches. Potential participants were contacted with a link to a short screening survey, and subsequently asked for an interview if appropriate for the study. The second recruitment strategy used was snowball sampling. After completing interviews, we asked participants to suggest colleagues in similar roles at their own or other news organizations, who we similarly screened. The third recruitment strategy was public posts via Facebook, Twitter, and relevant professional Slack channels. A link to the screening survey was included in the public post. If an individual filled out the screening survey and indicated that editorial decision making was part of their job, they were contacted for an interview.

3.2. Participants

Recruitment culminated in interviews with 18 professional journalists (denoted P1–P18 for attribution in findings), all currently working for news organizations in the U.S. conducted between August 2019 and February 2020. On average, interviews lasted 65 minutes. Participants were asked about their general gatekeeping practices, the role of social media in influencing these gatekeep-

ing practices, their understanding of social media algorithms, and how they believed their conceptions of these social media algorithms influenced their gatekeeping practices. Interviewees' positionality ranged across the field of journalism, both in terms of the market orientation of the news organizations they worked for and the positions they held within those news organizations, allowing us to gather a broad cross section of views. Three sets of two interviewees worked for the same news organization in different roles, allowing us to compare their perspectives. Further, some of the participants had experience working at more than one kind of newsroom and were able to speak to the different ways social media functioned in the various newsrooms they had worked in (see Table 1). The broad representation of roles and news organization types present in our sample allowed us to compare a range of 'folk theories' to reveal overarching patterns and reach saturation with respect to understanding emergent themes.

3.3. Analysis

Interviews were coded using qualitative thematic coding. Themes were derived both deductively from the posed research questions and inductively as new themes arose across the interviews (Gibbs, 2007). Interviews were constantly compared to elucidate new themes and patterns occurring across interviews (Strauss & Corbin, 1997).

4. Findings

4.1. What Algorithmic 'Folk Theories' Permeate Newsrooms?

Of the 18 journalists interviewed for this study, 15 were actively aware that social media platforms were operated by an algorithm of some type and had given thought to how these algorithms function in relation to news distribution. These understandings came from a mix of information sources including direct communication from social media platforms in the form of press releases and company representatives or 'point people' who would communicate directly with editors about what kinds of content they want on their platforms, experimentation to see what types of content would perform well or be 'liked' by the algorithm on different social media platforms, and discussions in public discourse. Overwhelmingly, interviewees understood social media distribution algorithms as filters that did or did not allow audiences to be exposed to their content. Interviewees positioned social media algorithms as a critical intermediary in getting news to their audiences. What varied amongst interviewees' 'folk theories' were the elements that led the algorithm to boost or limit exposure of a post, including engagement, publisher attributes, and the specific platform they were using.

4.1.1. Engagement

The main factor interviewees cited in deciding what content social media algorithms did and did not surface was engagement. Participants believed the more a news story was engaged with by users, the more likely a story was to make it into more people's newsfeeds. However, there was no clear consensus on how engagement was measured. For instance, while P9 thought the algorithm measured all the various facets of engagement, such as liking, sharing, or commenting "coming up with some kind of a score for the likelihood that you'll like something similar," P3 said that at different times the algorithm may favor one form of engagement over others.

Understandings of why engagement was the main metric by which algorithmic decisions were made also varied. While some journalists thought the algorithm mainly used engagement to help bring users content they were likely to be interested in, others saw engagement as a way for platforms to manage content distribution. As P6 explained:

> Let's say [Facebook] exposes a post to 10,000 people within our network, if all 10,000 started to click on it and not only click but comment, it became apparent that Facebook would open up that post in a way to more people and we would see hundreds of thousands of our users start getting exposed to that post.

In this way, P6 understood the algorithm's basis of engagement as a means of deciding not just what an individual user would want to see, but what users generally would want to see.

Many participants also viewed engagement measures as imbued with the corporate impulses of the companies that create these algorithms. They suggested that these algorithms were driven by engagement to fulfill social media companies' goals to increase their own advertising revenue and keep users on their platform for as long as possible. As P14 put it:

> What the platforms are trying to do is to keep people on their apps for as long as possible and to entice them to come back to those apps over and over and over again….What they want for us to do to help them do that is to provide those users with content that they want to engage with regularly.

Along these lines, some participants suggested that these algorithms were inherently friendlier to certain kinds of content that would produce these engaged behaviors in users: "I've seen kind of like gruesome things do really well….Obviously, the platforms are incentivized to like keep you coming back to the platform as a user….Outrage is a powerful emotion and works for a lot of these platforms" (P12).

Referring specifically to content medium, P14 also noted, "The Facebook algorithm prefers video and

Table 1. Study participants.

Interview ID	Current role	Org. primary medium	Org. scope	Org. size	Market orientation	Past relevant experience (within the past 2 years)
P1	Editorial producer	Television	National	Large	For-profit, advertising	
P2	Social media manager	Online/digital native	National	Small	For-profit, advertising	
P3	Audience engagement editor	Online/digital native	National	Medium	Non-profit, donor funded	Audience engagement editor at online/digital native news outlet
P4	Audience engagement editor	Newspaper	Local	Large	For-profit, advertising	
P5	Reporter	Newspaper	Local	Small	For-profit, advertising	
P6	Digital producer/reporter	Television news	National	Large	For-profit, advertising	Reporter at mid-sized local newspaper
P7	SEO manager	Newspaper	National	Large	For-profit, advertising	Social media & SEO manager at local television station
P8	Senior editorial manager	Online/digital native	National	Medium	Non-profit, donor funded	
P9	Reporter	Newspaper	National	Large	For-profit, advertising	
P10	News editor	Online/digital native	National	Medium	For-profit, advertising	
P11	Reporter	Online/digital native	National	Small	For-profit, advertising	
P12	Audience engagement editor	Online/digital native	National	Medium	Non-profit, donor funded	Audience engagement at a mid-sized local newspaper
P13	Social media and newsletter editor	Newspaper	National	Large	For-profit, advertising	
P14	Editorial analytic director	Online/digital native	National	Medium	For-profit, advertising	
P15	Social media editor	Newspaper	National	Large	For-profit, advertising	
P16	Audience analytics editor	Newspaper	Local	Medium	For-profit, advertising	
P17	Senior editorial producer	Online/digital native	National	Medium	For-profit, advertising	
P18	Deputy editor-in-chief	News agency	International	Large	For-profit, advertising	

prefers images…the sort of the hierarchy and format…from most engaging to least engaging is videos, images, text, links" (P14).

4.1.2. Publisher Attributes

Participants also noted that attributes of the publishers themselves may influence whether or not a story shows up in users' news feeds. For instance, some interviewees noted that social media algorithms may be friendlier to larger publishers, because they are more willing to pay for their content to be promoted or to 'pay to play.' As P7 suggested:

> The algorithm is more friendly towards larger publishers than its smaller publishers…they're probably forcing more publishers to pay to get that visibility, so they've pretty much cut down on the visibility that most publishers have on the web in an attempt to make them pay…for more of a visibility experience and for more of a chance to reach readers.

P7's comment speaks to the way some participants believed the algorithm may favor some news organizations over others based on the amount of economic and social capital they are seen as possessing within society. As P2 put it:

> Big news organizations like *The New York Times* and *The Washington Post* and even things like *Mother Jones* have better relationships with Facebook and Twitter than do smaller places. So even that level of it just having to do with how established a news organization is and how much time, especially Facebook gives them, contributes to the bias on the part of the programmers.

Some participants also suggested the algorithm may promote content based on the political ideology of a news outlet. During our conversation, P2 recalled a recent event that had led them to consider the way social media algorithms may take political ideology into account when promoting content:

> A big sort of underlying current has to do with a lot of complaints from people from the right-end of the spectrum in media…about the suppression quote unquote of conservative media and conservative voices….Facebook actually partnered, or were going to partner with *The Daily Wire*, which is Tucker Carlson's website to combat that suppression, which many of us in on the progressive side of things believe wasn't happening….I don't know how much of this actually happened because once the story came out, everyone kind of freaked out, but even just that public release of that statement kind of suggested a bias on the part of the people creating the algorithms.

Similarly, P11 argued that social media algorithms put people into ideological filter bubbles, and thus inherently take publisher ideology into account when promoting or suppressing content in users' newsfeeds.

4.1.3. Differences across Platforms

While interviewees spoke to general understandings of how social media algorithms worked, many of them noted that there were key differences in how they conceptualized the algorithm across various social media platforms. For instance, a handful of respondents noted that specifically on Facebook, a story would be demoted if it was posted twice within a short period of time:

> Facebook is so algorithmically interesting. We will not post the same story on Facebook within 48 hours of each other. That's kind of our tried and true rule because the way that the algorithm is, what I post right now, you could see in six hours. So that 48 hours kind of keeps it from having you being served the same story twice. (P15)

As P12 elaborated, for this reason, they believed the Facebook algorithm would "penalize" their content if they post any one story too close together. These comments speak to a general trend across our interviews of positioning the Facebook algorithm as more heavy-handed when compared to other social media algorithms.

Comparing the newsfeed algorithm on Facebook and the homepage algorithm on Reddit, one interviewee noted:

> Facebook, you have to do a number of things before you post the content to make sure that it's seen by enough people….If not, Facebook is just kind of not going to do it. Whereas a Reddit, which is a more like kind of like user-generated forum I guess you would say, it's more about knowing how to approach the different communities to engage with your content based on the rules and parameters that they're setting up. One is like, you know, computer generated, one is user generated. (P5)

As this comment points to, many of the participants conceptualized a clear distinction between the Facebook algorithm and other social media algorithms. Even though both platforms are based on user-generated content, Facebook's newsfeed algorithm was seen as automated, whereas the Reddit algorithm was seen as more dependent on actions of the users, due to its structure and use of subreddits. Making a similar comparison between that Facebook and Twitter algorithms, P3 noted:

> The reason that they've [Twitter] been able to sort of like skate under the radar is that their algorithm is a much lighter touch. It's always been dependent on

what the people you follow are doing. So, when I'm approaching it from a content point of view I know that someone will see this if someone in their timeline retweets it, like that's a much different conversation than like Facebook wants shares, like we must write a thing that will be shared.

In these ways, interviewees saw the Facebook algorithm in particular as being more pointed and opaquer when compared to platforms such as Twitter and Reddit.

4.2. How Do Algorithmic 'Folk Theories' Influence Content?

4.2.1. Influence on Editorial Decision Making

Six participants noted that they did not actively consider social media algorithms in any capacity in their editorial practices. Five of these journalists attributed this to the fact that either their newsroom is not concerned with social media audiences due to a niche news focus or they personally are not directly involved with or responsible for their newsroom's use of social media to distribute content. The last journalist who did not actively consider social media algorithms in their editorial decisions, P14, attributed this to the fact that they tend to find success on the platform, not through chasing the algorithm, but rather through focusing on the specific needs of their audience across various platforms. As they noted:

We base our distribution decisions on the audiences that are built there. When we put things in those platforms, they tend to be successful because they're geared for that platform. They're just not geared toward that platform for the reason of the algorithm. They are geared for that platform for the benefit of the audience.

On the other end of the spectrum, only two participants said they had been explicitly told not to cover a story because the content would not perform well on social media due to the algorithm's basis on engagement. In one instance P2 recalled:

There'd be a lot of pushback about investigations that I wanted to do on white supremacist stuff, nothing had been published about it or very little had been published about it…[it] would have been good journalism for the website to publish, but because it might not draw as much social media engagement, it was turned down.

Though their story met more traditional news values of timeliness, novelty, and importance, the fact that their editors presumed that it would not be engaging on social, and thus the algorithm would be unfriendly to the content, P2 was not allowed to cover the story. Similarly, P6 was once told by their editor that they could not pur-

sue a story on homelessness in the surrounding region because the topic would not perform well with their audiences on social platforms.

It is important to note that in both these instances P2 and P6 were answering to more senior editors, and thus may not have been aware of the exact thought processes and factors that may have influenced these decisions, and in actuality, these decisions may not have been made due to algorithmic considerations. Further, because we did not talk to their editors, we have no way to confirm their interpretation of these events. However, we suggest that because these participants perceived that these stories were killed due to the algorithm's basis on engagement, their own algorithmic 'folk theories' structured their understanding of these events, and in turn, their future sense-making practices around editorial decision making.

For the rest of participants, social media algorithms influenced the editorial decision-making processes in more complex and subtle ways. For instance, in some newsrooms, guidelines for social media platform usage issued to news organizations became a factor in the editorial process. In a few instances, interviewees mentioned that these guidelines were reinscribed into their own newsroom's editorial guidelines. If there were certain kinds of language or imagery these platforms explicitly said would be suppressed by the algorithm, editors made a note to exclude this content from their reporting at large.

Some interviewees also mentioned that if they believed a story did not perform well due to the algorithm, this influenced future newsroom editorial conversations about how resources may be allocated to covering a similar topic in the future. In one instance P16, who works for a local news publication, said that due to low levels of engagement on a national political story, their newsroom shifted reporting resources to focus on a more prevalent local political story which garnered more audience engagement. They subsequently only used wire copy to cover the national story. Similarly, other interviewees noted that more resources, especially from social media teams, may be invested in stories they presumed would perform well on social. Thus, while feedback from the algorithm does not necessarily foreclose reporters and editors from pursuing important stories, in some cases, it may potentially make them more hesitant to consider coverage of these stories in the future or shift how they cover such stories because of a presumed low return on investment.

4.2.2. Influence on Content Presentation and Framing

The majority of participants said the main way social media algorithms influenced their reporting was on the level of content framing. As P3 noted, "I think a good story across platforms is a good story. I think that the way you present the story…that's what changes." All of our participants noted that they would not reject a story outright because it does align with their understanding of what

content is preferred by platform algorithms. Rather, they try to find "different strategies to get Facebook's algorithm to cooperate" (P5), in terms of how they frame the story, tweaking headlines to be more engaging to readers, and being deliberate about the photos and videos they post alongside the stories. However, even to this point, some participants noted that they would only think about the algorithm in their framing to the extent that it aligned with their own editorial judgement. P14 noted how potential tension between traditional journalistic norms and social media algorithm's preference can limit the extent to which they reframe a story to be preferable to the algorithm:

> Facebook['s algorithm] really shares and engages with strongly worded arguments, but that doesn't necessarily…sometimes it does, but not always align with our editorial style and editorial angle. I'm not going to manufacture that kind of framing for a story that isn't really in line with that just because that's what Facebook's algorithm likes.

Thus, while some journalists believe social media algorithms have the ability to detect and promote more engaging content, they refuse to let this understanding completely dictate their editorial decision making.

4.2.3. Limitation of Influence

Despite these instances in which interviewees cited algorithmic folk theories in influencing aspects of their editorial decision making, all participants agreed that if they believed a story was worth covering, they personally would continue to pursue the story, whether or not they thought it would be promoted by the distribution algorithm. As P8 stated:

> Platforms are never telling you what to do week to week. It's more how the algorithms work….We tend to stay guided very much by editorial principles. So, we're trying to grow, we're trying to optimize, we're trying to find ways to engage…but not at the expense of our editorial identity.

Thus, while journalists' 'folk theories' of distribution algorithms may influence various aspects of their editorial decision-making process, it often does not supersede their autonomy as journalists to ultimately decide what is and what is not newsworthy. In part, this seems to be due to the opaque nature of these social media algorithms. As P17 aptly stated:

> It'd be a mistake to try to draw too many conclusions from the performance of any given [story]. It's a very messy ecosystem. So I don't think any of us are saying, "that didn't do well because of this algorithm and this is why"….I actually don't have very clear feedback on why things do well and why they don't.

Thus, the opaque nature of social media distribution algorithms may make journalists less inclined to give them weight, especially in light of other, perhaps more well-understood, means of reaching their audiences online such as their own online homepage, news aggregators, and SEO.

4.3. Moderating Factors in Algorithmic Influence

Drawing on Shoemaker and Reese's hierarchy of influences model (2014), here we elaborate some of the factors involved with journalists' understanding of algorithmic impacts on editorial decision making at different levels.

4.3.1. Organizational Level

On the organizational level, a media organization's business model, size/brand, medium, and editorial focus were all key modifying factors in influencing the extent to which journalists considered social media algorithms in their editorial practices. Journalists who worked for commercial (i.e., for-profit) news organizations whose financial success was heavily reliant on online advertising revenue were more attentive to social media algorithms in their editorial practices than those who worked for non-profit, donor funded news organizations. As P12 noted, unlike their previous experience working for a for-profit newspaper where the Facebook algorithm was often brought up in their editorial process, due to the high amounts of traffic they got from the platform, platform algorithms were not often brought up in the editorial process at their current non-profit news organization.

Interviewees who worked for larger, well-known news organizations often noted their newsroom was less concerned with considering social media algorithms in their gatekeeping practices. Talking about their current experience working at a large, mainstream national news outlet P6 said, "It's probably the first and only organization I've been at where they have such a global and national brand that the need to go viral through social media is not as important."

Some interviewees also noted how different mediums may be more or less likely to consider social media as a primary channel for reaching their audiences. For instance, P1 said the reason they do not think about social media algorithms is because, "I don't work on those mediums. I worked for the broadcast medium, right? So, my priority and my goal is to service content that works for that medium. Anything else is secondary."

Finally, the journalists interviewed for this study who have a more niche focus to their reporting attributed their lack of focus on social media algorithms to the fact that they are not on social media to reach a general audience, but a very specific audience.

4.3.2. Routine Level

On a routine level, the influence of social media algorithms seemed to be moderated by how much importance was placed on satisfying these algorithms within day-to-day newsroom practices. Journalists whose news organizations put more importance on social media felt more pressure to consider the algorithm in their editorial practices. Only four participants said they had not encountered discussions about these topics in their newsroom, and these four participants also did not think about social media algorithms in their editorial decision-making process.

Many interviewees who worked in social media and audience engagement related roles noted how they would often be tasked with helping editors and reporters translate content made for their primary platform(s) into what would be more satisfying to social media algorithms, in often indirect ways. As P4, who worked in audience engagement, put it:

> Algorithms are harder for people to grasp if they're not doing this every day. So, I might explain findings and I might explain an algorithm in the simplest way I can to get people to understand why our strategy is the way that it is, but it's not core to the conversations we're having with reporters and editors.

In this way, these specialized editors become intermediary gatekeepers who both control and temper other journalists' algorithmic understanding and thus, the influence of algorithms on editorial decisions. This intermediary role underscores the social dynamics inherent to routine practices which may end up privileging the algorithmic 'folk theories' of some, such as specialized editors or senior editors, in making final editorial decisions.

4.3.3. Individual Level

Participants' individual role in their news organization as well as their individual principles regarding their journalistic practices were key modifiers in the extent to which their understanding of social media algorithms influenced their editorial decision making. For example, P9 noted they did not think about social media algorithms at all on their editorial team, however this may be due to the fact that they report for a highly specialized division of their news organization. As a confirmation of this suspicion, P15, who worked in a role directly related to social media at the same news outlet, did consider the algorithm in their editorial practices and would occasionally prioritize sharing stories on social media they thought the algorithm would be favorable to.

Individual principles also played a role for some participants in the extent that they considered social media algorithms in their editorial decisions. Interviewees expressed that while some of their colleagues may be inclined to write a story because it would be algorithmically

successful, they would not, due to their commitment to the normative principles of journalism.

5. Discussion and Conclusion

This study took an empirical approach to the question of how social media algorithms influence modern day gatekeeping practices by professional journalists. We utilized the concept of algorithmic 'folk theories' to ascertain journalists' understandings of social media distribution algorithms, and further, the extent to which they perceive these understandings to shape and influence their editorial decision-making process. Empirically examining current theoretical models that position these algorithmic imaginaries as key influencers in shaping newsroom editorial decisions (Heinderyckx & Vos, 2016; Napoli, 2019) our findings suggest that, while ideas about social media algorithms have become a new element influencing gatekeeping practices, especially with regards to content framing and resource allocation to stories, they do not completely capture journalists' editorial decision-making process. Their influence is often limited to the extent that algorithmic newsworthiness aligns with traditional understandings of newsworthiness. Further, we found social media algorithms in particular, are becoming less influential in overall editorial decision making, as journalists turn to other, often more clear channels to reach audiences off-platform, such as content aggregators and SEO.

Yet these algorithmic considerations still pose new sources of tension for journalists as they attempt to consider these new editorial impulses alongside traditional norms of editorial decision making. As P5 put it, news organizations can no longer "force feed" readers the content they believe is important, and may in some instances find their understanding of newsworthiness being more reactive to what their audience will and will not engage with. In this way, the process of gatekeeping becomes a contested ground in which journalistic autonomy, to varying degrees, is negotiated alongside impulses to create content in line with understandings of social media distribution algorithms. Journalists may feel pressure to focus on covering a narrowly defined category of 'quantifiably' engaging content, over content that may hold traditional values of newsworthiness and be important for people to know.

We use the term 'quantifiable' here as a means of distinguishing the forms of content we see these algorithms pointing to compared to engagement within the context of the emerging field of engaged journalism. Where engaged journalism pushes journalists to think about deeply engaging with the communities they serve to bring them topics and content that are important to their social realities or "giving the audience what they want" (Ferrucci, Nelson, & Davis, 2020, p. 1588); algorithms define engagement through the narrow lens of quantifiable metrics (Diakopoulos, 2019), which push journalists to focus on content audiences will click on. Further, while au-

diences may click on a story because it is something they care about, they may also click on a story because it is sensational or evokes curiosity. In other words, what is 'quantifiably' engaging, is a much more reductive and often superficial understanding of engagement than it is in the context of engaged journalism. Modern day news editors must constantly weigh what they know as journalists to be important for creating an informed public against what they think the audience will find 'clickably' engaging, and thus, promoted through the algorithm. However, as noted, our findings suggest that these new impulses are rarely perceived to impede journalists from fulfilling their normative role of providing important social and political content.

Building on Shoemaker and Reese's (2014) hierarchical model of how media content is shaped, this article also argues that the degree to which journalists' algorithmic 'folk theories' influence gatekeeping differs at the organizational, routine, and individual levels. Importantly, in line with previous research at the organizational level, algorithmic understandings are often translated to larger newsrooms by social media or audience engagement editors (Assmann & Diakopoulos, 2017). In some instances, these editors tried to temper the degree of algorithmic influence on editors' and reporters' editorial decisions.

This study contributes to the growing literature on how digital circulation is changing and contesting traditional, normative ideas of journalistic gatekeeping and autonomy. As social media increasingly becomes an important news distribution channel, scholars have pointed to how traditional journalistic gatekeeping roles are continually contested and re-negotiated both prepublication (Tandoc & Vos, 2016) and post-publication (Hermida, 2020). Interrogating gatekeeping practices prepublication, our findings illuminate how professional journalists' understandings of social media algorithms act as a new force against which they must negotiate their traditional understandings of journalistic autonomy in their editorial practices. More broadly, findings from this study may inform journalism scholars, newsroom professionals, and even platform operators in understanding how conceptions of distribution algorithms are shaping the journalistic field.

5.1. Limitations

Findings from this study, while robust, are still based on a relatively small sample of journalists drawn from U.S.-based newsrooms, where the news media has historically been positioned as an institution which promotes western democratic ideals of knowledge, political participation and free speech. This culturally specific positioning of the news media heavily influenced the theoretical frameworks and the normative principles of journalism that our study interrogates, limiting the generalizability of our finding to other, especially non-western, cultural contexts. Future research might expand upon these findings, especially in different cultural contexts, using

methods such as representative surveys and quantitative data analyses.

Further, as an interview study, our data can only speak to what journalists perceive themselves to be doing, not what they actually do. Research on journalistic role performance (e.g., Mellado et al., 2020; Mellado & Van Dalen, 2014) has shown there is often a gap between journalists' perceptions of their performance and their actual performance both on the individual and organization level. We cannot account for response bias on the part of the journalists we interviewed, who despite the anonymous nature of the interviews, may not have been open to expressing or even aware of the full extent to which their algorithmic 'folk theories' influence their editorial decisions, especially in ways that would violate their own understandings of their normative journalistic roles. Future work should also consider complementary methods such as participant observation or content analysis in order to triangulate practices and outcomes relating to algorithmic 'folk theories.'

Conflict of Interests

The authors declare no conflict of interests.

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Article

Automated Journalism as a Source of and a Diagnostic Device for Bias in Reporting

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Abstract
In this article we consider automated journalism from the perspective of bias in news text. We describe how systems for automated journalism could be biased in terms of both the information content and the lexical choices in the text, and what mechanisms allow human biases to affect automated journalism even if the data the system operates on is considered neutral. Hence, we sketch out three distinct scenarios differentiated by the technical transparency of the systems and the level of cooperation of the system operator, affecting the choice of methods for investigating bias. We identify methods for diagnostics in each of the scenarios and note that one of the scenarios is largely identical to investigating bias in non-automatically produced texts. As a solution to this last scenario, we suggest the construction of a simple news generation system, which could enable a type of analysis-by-proxy. Instead of analyzing the system, to which the access is limited, one would generate an approximation of the system which can be accessed and analyzed freely. If successful, this method could also be applied to analysis of human-written texts. This would make automated journalism not only a target of bias diagnostics, but also a diagnostic device for identifying bias in human-written news.

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1. Introduction

In the current news media landscape, examining and acknowledging underlying bias is an important step in strengthening newswork and rectifying trust in journalism. As media is becoming reliant on metrics and personalization, striving for balance in issues such as gender, race, age, socioeconomic status, and story topics become increasingly poignant. Particularly when considering the expectations of the public of news as a representation of 'reality' (Reese & Shoemaker, 2016, p. 393). While working towards this goal, it is somewhat common to view automated journalism as a savior: an 'unbiased,' 'fair' and 'objective' decision-making system in comparison to the seemingly biased decision-making of humans. From this point of view, increased automation in the newsroom sounds like a match made in heaven, as newsrooms strive to be bastions of objectivity (Mindich, 2000, p. 1). As such, it comes as no surprise that many newsrooms are either already employing automated journalism or are interested in doing so (Sirén-Heikel, Leppänen, Lindén, & Bäck, 2019).

While the literature on automated journalism has presented various partially conflicting definitions (cf. Graefe, 2016), a very useful one is provided by Dörr (2016) and Caswell and Dörr (2018), who approach au-

tomated journalism through the technology employed. In their view automated journalism is about the employment of Natural Language Generation methods for producing news text. Natural language generation is a "subfield of artificial intelligence and computational linguistics that is concerned with the construction of computer systems that can produce understandable text in English or other human languages from some underlying nonlinguistic representation of information" (Reiter & Dale, 1997, p. 57). As such, Caswell and Dörr's (2018) definition explicitly excludes, for example, systems that produce summaries of news content written by other humans.

In this article, we use the term automated journalism along the lines of Caswell and Dörr (2018). In our view, automated journalism is the act of automatically producing a complete or near-complete news text from some underlying data. We include the qualifier 'near-complete' as a conscious acknowledgement of the view that a human can—and perhaps should—be included in the journalistic process of publishing. In practice, this means that our definition includes systems that produce story 'blanks,' raw textual material which already contain the main beats of the story but need further human editing before they are ready for audiences.

Irrespective of the precise definition of automated journalism, we believe it to be important to inspect the technology critically. As pointedly demonstrated by the now (in)famous analysis of automated prediction of recidivism (Angwin, Larson, Mattu, & Kirchner, 2016), algorithmic biases can have substantial effects. If the algorithms are viewed with an assumption of fairness, they present a danger of entrenching and hiding pre-existing biases. In the context of journalism, a profession and product defined largely by ideals such as objectivity, neutrality and factuality, it is crucial that unwanted biases are not allowed to entrench themselves unnoticed in the language and the content of news.

Other authors have previously researched both how algorithms can be investigated for journalistic purposes (Diakopoulos, 2015), described how algorithms involved in newswork could be made transparent (Diakopoulos & Koliska, 2017) and provided descriptions of how automation can help reduce bias in reporting (Fischer-Hwang, Grosz, Hu, Karthik, & Yang, 2020). Similarly, some technical works have investigated methods for identifying bias in non-journalistic contexts (e.g., Caliskan, Bryson, & Narayanan, 2017; Knoche, Popović, Lemmerich, & Strohmaier, 2019). In this article, we synthesize how these methods and ideas apply to diagnosing automated journalism itself for bias.

Such diagnoses can serve multiple purposes. First, they would quite naturally be of interest to researchers, as they would increase our understanding of the news media. Second, they would be of interest to third-party interest groups as a method for highlighting potential biases against any one of multiple demographics. Third, they present an opportunity to the newsrooms themselves to highlight the results of the audits

as benchmarks or as societal commentary. Statistics on the gender distribution in news stories is already used by some news organizations for benchmarking (Helsingin Sanomat, 2018).

In relation to bias in news journalism, bias has conventionally been studied from the perspective of an autonym to objectivity, having adverse effects on the journalistic ethos to report reality truthfully, and as a symptom of partisanship (Hackett, 1984). As journalism is conceptualized as the fourth estate in democratic societies, bias has largely been tied to politics and ideology, editorial policy and individual journalists. The complexity of journalistic bias has gained a new dimension with digitalization. The shift towards mobile and the changes in audience behavior has increased the role of the audience, affecting news values and journalistic work (Harcup & O'Neill, 2016; Kunert & Thurman, 2019). Personalization, in effect a form of bias, has become a strategy for media organizations and platforms for creating customer value. Catering for audience tastes based on implicit or explicit user information can also increase the value for automated news, for example based on location, as suggested by Plattner and Orel (2019). However, as Kunert and Thurman (2019) found in their longitudinal study, most news organizations remain committed to exposing their audience to a diversity in news stories, reaffirming the prevailing framing of quality journalism.

Distinguishing between 'acceptable' bias, such as exhibited in personalized sports news, and 'unacceptable' bias, e.g., favoring certain ethnicities, is a value ridden process. Both are examples of 'selectivity,' as suggested by Hofstetter and Buss (1978, p. 518), or more generally framing (see Entman, 1993; Scheufele, 1999). Only shared values decide that one is acceptable and the other is not. Encoding such values exhaustively into any automated procedure is extremely difficult. It is unlikely that automated methods will be able to make this distinction outside of the most blatant cases. As such, when we refer to 'detecting bias,' 'causing bias,' etc., we are in fact talking about biases of 'undetermined polarity,' meaning that additional human analysis is required to determine whether the potential biases detected are acceptable or not. Nonetheless, due to the effects of media on audience perceptions, consciousness of bias and embedded values in automated journalism is of paramount importance.

2. Bias in Automated Journalism

Despite increased media attention, the term 'algorithmic (un)fairness' is still unfamiliar for many (Woodruff, Fox, Rousso-Schindler, & Warshaw, 2018, pp. 5–7). This is understandable as the 'unbiasedness' and 'fairness' of algorithms is often expressed as a selling point of automation: The prospect of a perfectly fair and objective computer replacing the biased human as the maker of hiring decisions, arbitrator of loan applications, and judge of those accused of crimes is very enticing.

Automated journalism has mostly been employed in settings where the objectivity standard can be considered the highest, such as weather reports (Goldberg, Driedger, & Kittredge, 1994) and financial news coverage (Yu, 2014). While automation has since been applied to domains where news media often produce more subjective commentary, such as elections and sports (Diakopoulos, 2019, p. 107), to the best of our knowledge even in these domains the systems tend to be applied to what we consider the objective side of the topic, reporting results rather than analysis.

While this positioning of automated journalism in the larger journalistic field is clearly driven by technology to some degree (i.e., the technology being unsuitable for other, more subjective, story types; see e.g., Stray, 2019), it seems that the view that objectivity is the best aspect of automation is also an influencing actor. The views of the media seem to be exemplified by the words of an editor of a regional media company, who stated that automatically produced stories represent "facts…and figures, not someone's manipulated interpretation" (Sirén-Heikel et al., 2019, p. 56). To us, such beliefs indicate two crucial assumptions: that removing the individual—or the first level of hierarchy of influences (Reese & Shoemaker, 2016)—is sufficient to remove bias, and that using automation indeed removes the effect of the individual. We will return to these assumptions in the conclusions of this article.

As increasingly acknowledged both within and without computer science, the use of algorithms is not a panacea to removing bias from society, if such a thing is feasible at all. In fact, automated systems are increasingly recognized as reflecting existing societal biases (Selbst, boyd, Friedler, Venkatasubramanian, & Vertesi, 2019) and due to the 'objective' imagery associated with them they might further systematize these biases. At the same time, it is hard to define what, exactly, it would mean for an algorithm to be unbiased or 'fair' (Woodruff et al., 2018, p. 1), with some notions of algorithmic fairness even being fundamentally incompatible with each other (Friedler, Scheidegger, & Venkatasubramanian, 2016, p. 14). As an example of the complexities of the topic, consider whether a system that simply reflects some underlying societal bias—and would automatically stop doing so if the societal bias was removed—is by itself biased? Due to these difficulties in defining what, precisely, is fair and unbiased, we do not focus our efforts on identifying what is unbiased or proscribing how the world should be. Instead we will next consider a few examples of cases where a system for automated journalism is either clearly biased, or at least raises the question of whether the system or the society it is employed in is biased.

We base our analysis on the observation that, in very broad conceptual terms, natural language generation can be thought of as consisting of three major subprocesses: deciding what to say, deciding how to say it, and actually saying it (Gatt & Krahmer, 2018, p. 84; Reiter & Dale, 2000, p. 59). The distinction between the last two steps is that whereas the second step decides e.g., what words to use, and in which grammatical forms, the actual inflection is done at the third step. It seems clear to us that if a system for automated journalism results in biased output when starting from data considered objective, the bias must have been introduced in either the first or the second step.

At the same time, whether based on human-written rules or machine learning, a system for automated journalism can also produce biased output text if the system inputs are biased. For example, an ice hockey reporting system will only produce news about the male leagues if it is never provided the results for the female leagues. Bias resulting from biased input is, however, distinctly different from biases built into the automated systems, with the operative difference being which part of the process must be modified to address the bias. Any system will misfunction when presented with incorrect inputs, or as the saying goes: 'garbage in, garbage out.' While a system receiving incorrect information indubitably reflects badly on the journalists and editors responsible for the system, it does not necessarily indicate that the system itself is malfunctioning. For this reason, in order to understand the weaknesses of the system, we must first focus on whether it malfunctions in the case of correct, i.e., unbiased, inputs. As such, going forward with our analysis, we will assume that the system is receiving correct, unbiased inputs.

As noted above, biases introduced by the system must be related to either content selection or the language used in the text. We will now consider the kinds of biases that could be introduced in both steps separately.

2.1. Bias in News Content Selection

With bias in news content selection, we refer to any phenomenon where the inclusion and exclusion of pieces of information from a news article reflects a potential bias. A real-life example of such a bias is described by Hooghe, Jacobs, and Claes (2015), who observe that female members of parliament received less speaking time than their male colleagues in Belgian media. Similar phenomena have been observed, for example, in sports reporting, where the coverage of male sports significantly eclipse the coverage of female sports (Eastman & Billings, 2000) and in reporting about same-sex marriages, where male sources were more likely to be quoted than female (Schwartz, 2011).

Phrased in terms of automated journalism, we can imagine biased automated systems that e.g., prioritize reporting election results of male candidates before those of female candidates. However, it is important to note that simply quoting more male politicians than female politicians does not necessitate that the automated system has a gender bias. Instead, it might be simply reflecting underlying societal factors and biases: If there are 99 male politicians to one female politician, a system ran-

domly picking a candidate to quote would mostly quote males. A more nuanced analysis is needed in such cases.

These content selection biases can, however, be more subtle and less obvious. It might be, for example, that a news text categorically only includes the racial background of a suspect if the suspect is part of an ethnic minority. Or similarly, reporting of a car crash might only mention the gender of the driver if they are female. In both cases, such reporting could entrench prior reader biases, either affirming their biased beliefs (those who are part of an ethnic minority commit more crimes, women are worse drivers) or not presenting contradicting evidence (a suspect of unspecified ethnicity committed a crime, a driver of unspecified gender crashed).

These examples show that bias can result not from just exclusion of information (i.e., protected classes being ignored or underrepresented in reporting), but also from highlighting the membership in a protected class.

2.2. Bias in News Language

It is also possible for the language of the news to be biased even in cases where the information content itself is not necessarily so. For example, Eastman and Billings (2000, p. 208) observe a tonal difference in sports reports, where male athletes were discussed in an enthusiastic tone, while female athletes were discussed in a derogatory tone.

Such linguistic bias can manifest in the minor difference in the nuance of the words that are used in the news text. For example, there is significant tonal difference in whether a car accident is described using language where the actor of the event is the pedestrian ('a pedestrian ended up being hit by a car'), the car ('a car ran over a pedestrian') or the driver of the car ('a driver ran over a pedestrian'). Minor changes in the lexical choice presents the driver of the car as having a passive role in the event, almost making them an observer, even if the facts of the event place most of the blame on the driver. Seemingly minor choices such as these can be seen as biased against those of lower socioeconomical status, who are less likely to own a car and more likely to be pedestrians.

These kinds of linguistic biases are very rarely as obvious as the content selection biases defined above but are nevertheless relevant. Minor changes in lexical choice can have significant effect. The same increase in unemployment can be described as an 'increase' or as 'rocketing' with significantly different tone. Similarly, consider the difference between describing a 17-year-old perpetrator of a crime as either 'boy' or 'young man': While neither is significantly more accurate than the other, they carry significantly different tone and can have significant effect on how the reader perceives the perpetrator.

There is nothing inherent to automated journalism that would prevent such biased language from being produced by an automated system, just like there is nothing inherent to the automation that would prevent systems from having biases in content selection. Next, we consider the mechanisms that would allow such biases to appear in the text produced by automated journalism.

3. The Mechanisms for Biased Automated Journalism

The previous sections highlighted ways in which the output of a system for automated journalism could be biased. It did not, however, address the mechanism by which such biases end up in the system. We now turn to this question.

Automated journalism, as in the automated production of news texts, can fundamentally be achieved by two technical methods (Diakopoulos, 2019). The first of these is via algorithms consisting of human-written rules that directly govern the actions of the system. The second is via algorithms that learn the rules from examples provided by the system creators, also known as machine learning. We will next discuss both approach in turn, with special focus on how biases might end up being encoded in such systems.

3.1. Bias in Rule-Based Systems

Rule-based systems for automated journalism are based on explicit rules programmed by human programmers, such as 'start an article on election results by mentioning who is now the largest party, unless some party lost more than 25% of their seats, in which case discuss them first.' Such rules, however, can be implemented using various technical methods and are best defined by the common factor that they are not automatically learned from examples. As these systems are, fundamentally, driven by rules and heuristics produced directly by humans, the principal reason for these systems to produce biased content is by the human-produced rules being biased.

Commercial actors providing systems for content creation or distribution, particularly those involving automation or machine learning, tend to keep their systems' details largely hidden from the research community. Naturally, this also holds true for systems used for automated journalism. However, interviews with media industry representatives indicate that most of the systems employed in the real-world newsrooms are indeed rule-based, rather than based on complex machine learning (Sirén-Heikel et al., 2019). Based on the limited evidence available, such as the few open source systems (e.g., Yleisradio, 2018), these systems are often based on what can be described as 'story templates.' These templates are, in broad terms, the algorithmic equivalent of the combination of a Choose Your Own Adventure book and a Mad Libs word game. The software inspects the input data, and based on human-written rules, selects which spans of text to include in the story and in which order. These 'skeleton' text spans contain empty slots, where values from the input are then embedded to produce the textual output of the story. While significantly more complex rule-based methods exist, espe-

cially in academia (see, e.g., Gatt & Krahmer, 2018, for an overview), the decree to which they have entered use in the industry is not clear to us.

Irrespective of the technical details of the system, the important factor in these types of rule-based systems is that on a fundamental level they work based on explicit instructions that have been manually entered by humans. In simpler systems these rules can then be trivially investigated for potential bias: if some part of the system makes a decision based on a protected attribute, such as gender, it could be considered immediately suspect. This kind of surface-level inspection would reveal trivial cases of bias, such as where a human programmer has encoded in the system that election results pertaining to male candidates are more interesting than similar results pertaining to female candidates.

However, such clear-cut examples are, we hope, rare. We believe it is much more likely that the system incorporates some heuristic that reflect unconscious underlying biases, with unintended results. This becomes increasingly probable as the system complexity and the amount of automated data analysis conducted by the system increase. For example, a system producing news about the local housing market might use the average housing prices of an area as part of its decision making about which areas to discuss in the produced news text, assuming a higher price equates to higher newsworthiness. These housing prices, however, are likely to be well correlated with socioeconomical factors of the area population, resulting in coverage that is biased against populations of lower socioeconomical status as a result of not discussing aspects of the housing market relevant to them.

An even more nuanced example of the same phenomena could be observed if the decisions on what areas to report on were based on the absolute change in the housing prices; if the housing prices changed everywhere by the same percentage, the more well-off areas would see significantly higher absolute changes, which in the case of our hypothetical system would result in the same effect as above. As such, the investigation cannot be limited to only protected attributes, but rather all attributes that correlate with protected attributes must also be inspected.

3.2. Bias in Machine Learning Systems

The other major archetype of systems for automated journalism is presented by systems that employ machine learning. These systems differ from the rule-based systems by the fact that their decision-making is not based on human-written rules and heuristics, but rather on rules identified from training data. Most commonly, in supervised machine learning, this training data takes the form of pairs of 'given this input, the system should produce this output,' such as news texts previously written by human journalists paired with the data that underlies each text. While some works have been published on un-

supervised text generation methods where the data is not aligned in this way (e.g., Freitag & Roy, 2018), to our knowledge such systems are still rare and suffer from severe limitations in terms of their applicability to automated journalism. A detailed description of unsupervised automated journalism is thus skipped.

In machine learning systems (see e.g., Flach, 2012, for an introduction to machine learning), the human programmers do not explicitly provide the actual rules of processing, but rather provide a framework and a set of assumptions. For example, in the case of a system for producing automatic textual reports of election results, a programmer might make the assumption that the journalistic process being replicated is, effectively, a 'translation' from the numerical results released by the election organizers to the natural language news report. As such, they might elect to implement a neural machine learning model similar in architecture to those used in machine translation, and train it by using examples of 'given this result data, the system should output this textual description.'

The machine learning process then identifies a specific model (analogous to the ruleset developed by-hand above) that minimizes the average difference between what the model outputs for an input in the training dataset and what the expected output was. In other words, the training attempts to identify a process that mimics the process that generated the training samples as closely as it is able. The degree to which this process succeeds is still limited by factors such as the amount of training data (it is hard to learn things of which there are no examples) and the model architecture (the learned model is restricted by the architecture selected by the human developer, and a badly selected architecture might be fundamentally unable to mimic the process that generated the training data).

Another issue is presented by overfitting, where the learned model might incorporate assumptions that hold for the training data but do not generalize to other cases. Even state-of-the-art machine learning systems for natural language generation suffer from this type of behavior in what is referred to as 'hallucination' in the technical literature. That is, they produce output not grounded in the input data, but based solely on strong correlations found in the training data. Such behavior has been identified in state-of-the-art systems in various domains, ranging from very constrained restaurant description tasks (Dušek, Novikova, & Rieser, 2020) to sports news generation (Puduppully, Dong, & Lapata, 2019).

When discussing bias, the model definition, its architecture, is significantly less important than the examples from which the system is trained. An important aspect of supervised machine learning is that the system truly does its best to mimic a process that could have generated the training data it observes. This means that even if the programmer allowed the system to consider some protected attributes, such as gender, the system only does so if the behavior in the training data seems to be influenced by

said attributes. This, however, also means that if there are any biases in the training data, these are also learnt. This applies whether the biases are intentional or not.

At the same time, however, simply removing a potentially biasing variable from the input is insufficient to ensure that the system does not act in a biased manner and many 'debiasing' techniques can simply hide the issue without solving it (e.g., Gonen & Goldberg, 2019; Kleinberg, Ludwig, Mullainathan, & Rambachan, 2018). As long as the underlying bias exists in the training data, even if the identified variable causing the bias is removed, the system will locate so called proxy variables to encode said bias into the model (Kilbertus et al., 2017). For example, if the training data for a system making loan decision was provided by humans that were discriminatory by providing smaller loans to non-white applicants, a sufficiently complex model might learn to observe whether the name of the applicant or their postal code is indicative of a high likelihood of being non-white as a proxy for the race of the applicant, even if the race was not explicitly provided as input to the system. In the context of automated journalism, a machine learning system would thus learn any biases present in the news stories that were used to train it. As such, the 'unbiased' algorithm would simply be faithfully replicating and entrenching any pre-existing biases in the news text used to train it.

4. Detecting Bias in and with Automated Journalism

As for detecting bias in systems for automated journalism, we see three primary scenarios where such an investigation could be undertaken: a scenario of a clear box system, a scenario of a cooperative operator with a black box system, and a scenario where only system outputs are available. We next discuss each in turn, considering how the system might be diagnosed for bias given the constraints of the scenario.

4.1. Full Transparency

Clear box investigations depend on the ability to inspect the internal workings of the automated journalism system. As such, they are only possible in cases where the operator of the system is cooperative, allowing access to the source code of the system. Furthermore, they are in practice limited to rule-based systems: even if a modern machine learning model was made available to experts, the systems tend to be so immensely complex that they are, in practice, black boxes.

Given access to a rule-based system, it should be in principle possible to investigate the logic and the rules employed by the system and determine whether any of them are blatantly biased. For example, as noted previously, any rules where the system directly considers a variable related to, for example, gender, is immediately suspect of introducing gender bias into the report and can be investigated further. Such an investigation, how-

ever, becomes increasingly difficult when one attempts to identify nuanced effects such as those described in the housing price report example shown before.

To identify more nuanced (potential) biases and to investigate systems that are too complex for manual inspection of the system's internal workings, a method based on system input variation might be more practical. Notably, this method still requires some level of cooperation from the system operator but does not require access to the system internals, and as such is also applicable to black box systems. In this process, samples of slightly varied system inputs are prepared, and ran through the system in sequence and the results inspected for differences.

4.2. Cooperative Operator with a Black Box System

An example of such a cooperative black box case would be a machine learning system producing reports of election results. In such a case, one can take the election results that act as the system's input and produce a variation of those results where potentially bias-inducing variables are modified. For example, the researcher could produce a copy of the system input where all the genders of the candidates have been changed but the input is otherwise left as-is. Producing output from both the unmodified and modified inputs would then allow for a comparison of the output texts, so that any differences can be inspected for potential bias. Continuing the example, observing changes between the two datasets in, for example, the order the results are discussed in would give rise to suspicion of potentially biased treatment of the different genders. In fact, any significant changes in lexical and content selection should be investigated in detail.

4.3. Output Only

In cases where the system operator is not cooperating the investigation must be conducted solely based on the available system outputs. From the point of view of the applicable methods, this case is indistinguishable from the case of a researcher conducting an analysis of human-written news, with the potential exception of significantly higher amount of texts available for analysis. We hypothesize, that in this case the role of automated journalism can be reversed, so that automated journalism can help highlight bias in news texts, whether produced by humans or computers.

A relatively simple method for natural language generation is provided by language models. In general terms, a language model is a machine learning model that describes how likely a sentence is based on training data the model was trained on. Consequently, many language models can be used to generate language by querying the model for 'what is the most likely next word, if the preceding words are….' Due to their simplicity, they are currently not very useful for generating real news, even if they do have other applications in the field of natural

language processing. At the same time, if trained on a large collection of news articles, they in effect learn what an 'archetypical' news article looks like and can mimic that style.

Previous technical works, such as those by Sheng, Chang, Natarajan, and Peng (2019), have demonstrated how language models can be interrogated for bias. In their experiment, they construct pairs of sentence starts, such as 'the woman worked as/the man worked as,' and completed the sentences using a language model. Their analysis of the sentence completions revealed the language model had internalized deep societal biases and reflected them in its output.

While standard language models are not suitable for automated generation of real news, we hypothesize that a language model trained on a sufficient amount of training data produced by a news automation system would learn and retain all the biases of the original system, in effect functioning as a proxy. The language model could then be interrogated for bias, for example using the method of Sheng et al. (2019), and any evidence of bias in the language model would be indicative of a potential bias in the underlying system.

While the wide variety of methods for language modelling are too numerous to enumerate here, it is notable that the most recent advances in language modelling take advantage of word embeddings (e.g., Bengio, Ducharme, Vincent, & Jauvin, 2003; more recently, Devlin, Chang, Lee, & Toutanova, 2019; Peters et al., 2018). In word embeddings (e.g., Mikolov, Sutskever, Chen, Corrado, & Dean, 2013), words (or sometimes subword-units) are represented as points in a multidimensional vector space. Due to the way the word embedding model is trained, these spaces have several intriguing properties, a principal one being that words that are used in similar contexts in the observed texts are located close to each other in the vector space. Therefore, the nearness of two words in this vector space approximates the semantic relatedness of the words. This same mechanism, however, means that word embeddings trained on a text corpus internalize biases from said corpus (e.g., Gonen & Goldberg, 2019). This has two important consequences.

First, when training a language model as suggested above, care must be taken to ensure that bias is not introduced into the language model via use of word embeddings pretrained on another corpus. Consider, for example, a situation where a language model trained on news texts shows potential bias. If the language model is based on word embeddings pretrained on a highly biased corpus, it would not be clear to what degree the observed biases were incorporated into the model from the news text and to what degree from the biased word embeddings. This problem can be avoided by either using a language model that is not based on word embeddings, or preferably by training both the language model and the word embeddings from scratch. While this procedure prohibits taking advantage of the state-of-the-art pretrained language models such as BERT (Devlin et al.,

2019) and ELMo (Peters et al., 2018), it should ensure that any biases observed in the final model come from the texts being inspected.

Second, the tendency of word embeddings to internalize biases also present an opportunity. Previous works (e.g., Caliskan et al., 2017; Knoche et al., 2019) have trained word embeddings from various textual corpora in order to detect biases in said texts. For example, given a word embedding model trained on a newspaper corpus, it is possible to inspect whether keywords indicating either a positive or negative affect are, on average, close to the word 'white' than to the word 'black.' A situation where positive keywords are on average closer to the word 'white' than to 'black' indicates that the corpus contains potential racial biases.

Notably, neither of these last two methods (training and inspecting either language models or word embeddings) is in any way dependent on the data underlying the model being derived from a news generation system. Rather, they could be applied to all kinds of news texts, including those produced by human journalists. Similarly, these latter methods might be useful even in scenarios where the system operator is cooperating. As noted by Diakopoulos (2015), reverse engineering can "tease out consequences that might not be apparent even if you spoke directly to the designers of the algorithm" (p. 404). Indeed, it seems unlikely that a rule-based system for automated journalism would be biased on purpose, and more likely that any potential biases are subtle and introduced unintentionally.

5. Conclusions

In this work, we have briefly described what automated journalism is, including a description of the two archetypical technical methods to conduct news automation: rule-based and based on machine learning. We have identified two major categories of bias that can appear in the output of such systems: content bias and language bias. We then provided a description of the mechanisms that might result in biased output from systems for automated journalism, as well as mechanisms through which these biases could be identified. An important observation is that while the mechanisms require an underlying human source for the bias, the biases can emerge in the system without human intention and in very subtle manners.

Our investigation of bias in automated journalism highlights that automatically produced text needs to be inspected for bias just as human-written texts do. The applicable methods, however, depend on the level of cooperation from the system operator as well as the technical details of the system. In cooperative cases more rigorous inspections of automated systems are possible, yet in some cases the investigation is not meaningfully distinguishable from an investigation of human-written texts. As a result, we note that methods such as the one proposed above could also be applied to investigating the biases of human-written news.

We observed that the belief of unbiased automated journalism seems to predicated on two assumptions: that removing the individual—or the first level of hierarchy of influences (Reese & Shoemaker, 2016)—is sufficient to remove bias, and that using automation indeed removes the individual's effect.

Starting with the second assumption, our investigation above indicates that while automation can obscure the influence of the individual, which would naturally lead to assumptions such as above, automation does not remove the influence of the individual. In case of a rule-based system, the individuals who influence the output are those who build the system and decide what rules it should follow. In case of machine learning, the individual is further removed but still has immense effects on the system's actions through their role as a producer and selector of the training data. In either case, the individual remains, albeit obscured by the system itself.

As for the other assumption, that removing the individual removes bias, we point to the fact that this assumption ignores the possibility of influences imposed by the higher levels of Reese and Shoemaker's (2016) hierarchy. In other words, the belief that the removal of the individual removes bias is predicated on the assumption that bias is created by the individual. Such beliefs overlook societal and organizational biases and the nature of the organization and the society as a collective of individuals.

It warrants repeating that automated journalism fundamentally requires an individual or a collective of individuals to define (whether explicitly through programming rules or implicitly by producing and selecting the training data that tells the system what to do) a set of frames through which the data underlying the story is portrayed (e.g., Entman, 1993; Scheufele, 1999). Any claim of the resulting system being 'unbiased' implicitly insinuates that the frames employed are also unbiased, or alternatively overlooks their existence in the first place. Unless these frames are highlighted and scrutinized—both in academia and outside of it—they risk being entrenched and becoming axiomatic. It is for this reason that investigating automated journalism for bias is so important: By obscuring the individual, automation risks obscuring the framing, hiding both the underlying individual and structural biases. This also has consequences for researchers investigating automated journalism for bias: significant care must be taken to identify origins, originators and contexts of any identified biases. For example, the use of machine learning does not preclude a bias originating from a specific individual.

We believe future work needs to be undertaken on at least two fronts. First, computational methods for identifying bias should be extensively trialed in terms of applicability to the analysis of journalistic texts, with the aim of producing a clear description of usefulness and usability, especially to those without extensive technical knowledge. Optimally, the work should lead to easy-to-use tools for both technical and non-technical researchers. Second, the methods for user-cooperative scenarios need to be tested in detail on real-world systems for automated journalism to determine best practices for conducting such audits, and for determining the origins of the discovered biases.

Automated journalism raises a multitude of ethical questions without obvious answers. For example, attributing authorship of computer-generated texts is a difficult task (Henrickson, 2018; Montal & Reich, 2017), which in turn raises the question of credit, and responsibility, for the end product. It is our opinion that automated journalism cannot be allowed to become a smoke screen for eluding responsibility. In terms of practical recommendations, we point the reader towards the succinct but well thought out guidelines published by the Council for Mass Media in Finland (2019). In short, we concur with the view that automated journalism is a journalistic product, hence the control and responsibility must always reside with the newsroom, ultimately in the hands of the editor in chief. In order to ensure that editors can take this responsibility, developers of automated journalism are liable for creating systems that are transparent and understandable, with auditing providing one way of achieving this goal.

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Conflict of Interests

The corresponding author is employed in a joint research project with various European media companies.

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Review

Automated Journalism: A Meta-Analysis of Readers' Perceptions of Human-Written in Comparison to Automated News

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Abstract

This meta-analysis summarizes evidence on how readers perceive the credibility, quality, and readability of automated news in comparison to human-written news. Overall, the results, which are based on experimental and descriptive evidence from 12 studies with a total of 4,473 participants, showed no difference in readers' perceptions of credibility, a small advantage for human-written news in terms of quality, and a huge advantage for human-written news with respect to readability. Experimental comparisons further suggest that participants provided higher ratings for credibility, quality, and readability simply when they were told that they were reading a human-written article. These findings may lead news organizations to refrain from disclosing that a story was automatically generated, and thus underscore ethical challenges that arise from automated journalism.

Issue

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1. Introduction

Automated journalism, sometimes referred to as algorithmic journalism (Dörr, 2016) or robot journalism (Clerwall, 2014), alludes to the method by which algorithms are used to automatically generate news stories from structured, machine-readable data (Graefe, 2016).

The idea of news automation is not new. Half a century ago, Glahn (1970) described a process for automatically generating, what he called, "computer-produced worded weather forecasts." Basically, his idea was to create pre-written statements that describe different weather conditions, each of which corresponds to a particular output of a weather forecasting model (e.g., the combination of wind speed, precipitation, and temperature). This process is similar to today's template-based solutions offered by software providers in which a set of predefined rules are used to determine which prewritten statements are selected to create a story (Graefe, 2016).

Another domain that uses automated text generation is the financial news. In 2014, when the Associated Press gained much public attention for the decision to automate earnings reports (White, 2015), Thomson Financial (today part of Thomson Reuters) had already been automating such stories for nearly a decade (van Duyn, 2006).

It is no coincidence that weather and finance were the first applications to utilize news automation. In both domains, structured data, a requirement for news automation (Graefe, 2016), are available. Furthermore, data quality is high for these applications. Weather data are measured through sensors with relatively low measurement error. Likewise, the accuracy of company earnings or stock prices is critical for consumers of financial data.

What is new is the increasing abundance of structured and machine-readable data in many other domains. Governments are launching open data initiatives, sensors are constantly tracking environmental or health data, and users are leaving traces with virtually anything they do online. Such data can be used to generate automated news stories and thus serve as one of the technology's major drivers. Another important driver is economic pressure: News organizations need to save costs, increase news quantity (e.g., covering niche topics), and reach new target audiences (Graefe, 2016).

Promises of automation in increasing efficiency are manifold. As outlined by Graefe (2016), automating routine tasks has the potential to save resources and thus leave more time for journalists to do more important work, such as fact-checking or investigative reporting. Furthermore, automation can speed up news production and essentially enable publication as soon as the underlying data become available. Finally, algorithms tend to make fewer errors than human journalists and can personalize stories towards readers individual needs, and if necessary, in multiple languages.

Nevertheless, Dörr (2016) found news automation to be in an early market expansion phase at best. This situation does not seem to have changed much over the past four years. Providers of automated text generation still list few media organizations as their clients, although this may have to do with reasons of commercial confidentiality. That said, it is difficult to find regular text automation in high-profile publications, apart from the regularly cited one-off or experimental projects such as the Heliograf (*The Washington Post)* or ReporterMate (the Australian edition of *The Guardian*). Other major publications such as *The New York Times* stated that they are not planning to automatically generate news, despite having experimented with automation technology to personalize newsletters or moderate readers' comments (Peiser, 2019).

One reason for why news organizations refrain from using the technology, despite its economic potential, may be concerns that their readers would disapprove of automated news. According to the Modality–Agency–Interactivity–Navigability model (Sundar, 2008), readers may have a conflicting perception of automatically generated news. On the one hand, they may prefer human-written articles because they regard journalists as subject-matter experts (authority heuristic), or because they feel that they are communicating with a human rather than a machine (social presence heuristic). On the other hand, the machine heuristic suggests that readers regard automated news as free of ideological bias and thus more objective.

To answer such questions, researchers in different countries have conducted experimental studies to analyze how readers perceive automated news in comparison to human-written news. While sharing the common goal to better understand readers' perceptions of automated news, these studies often differed in their design.

For example, some studies showed readers the same text and manipulated the byline as either written by a human or by an algorithm, whereas others revealed the true source of the articles. Yet another group of studies asked participants to rate either a human-written or an automated text, without revealing any information about who wrote the article.

The present meta-analysis summarizes available evidence on readers' perception of automated news to date, drawing on 11 articles, published in peer-reviewed journals between 2017 and 2020. Our goal is to give readers quick and easy access to prior knowledge. We provide an overview for which countries, domains, and topics evidence is available, which designs have been used to study the problem as well as how researchers recruited study participants. More importantly, we provide effect sizes aggregated across studies, while distinguishing between descriptive and experimental evidence as well as between effects that can be attributed to the article source (i.e., the author) and the message itself.

2. Method

2.1. Article Search

We included only studies published in scientific peer-reviewed journals in the English language. Studies had to provide experimental evidence on readers' perceptions of human-written news in comparison to automated news with respect to credibility, readability, and expertise. These are three of the four constructs that Sundar (1999) identified as central when people evaluate news content (the fourth one, representativeness, was omitted as it applies to news sections rather than single articles).

Our Google Scholar search for [('automated journalism' OR 'robot journalism') AND experiment AND perception] in October 2019 yielded 211 articles. After reading the title and abstract of each article, 34 articles were identified as potentially relevant and were thus read in full length by at least one of the authors. The articles by Jia (2020) and Tandoc, Yao, and Wu (2020) were added later. A total of 11 articles matched the inclusion criteria outlined above. Table 1 lists the 11 articles included in our meta-analysis. Three articles were published in *Digital Journalism*, and two articles each in *Journalism* and *Computers in Human Behavior.* The remaining four articles were published in four different journals, namely *International Journal of Communication*, *Journalism Practice*, *Journalism & Mass Communication Quarterly*, and *IEEE Access.*

2.2. Studies

We only included studies with a particular study design in our meta-analysis. These studies presented recipients with a short news story, in which either the author (journalist or algorithm), the attributed author (journalist or

algorithm), or both were experimentally manipulated. Recipients would then rate the article they had just read in terms of (at least one of the dimensions) credibility, quality, and readability.

Given that we were interested in readers' perceptions of human-written vs. automated news, we excluded experiments that used journalists as recipients (e.g., Jung, Song, Kim, Im, & Oh, 2017, Experiment 2) or analyzed hybrids of human-written and automated news (e.g., Waddell, 2019a). We also excluded studies that did not report effect sizes (e.g., Clerwall, 2014) or used a different experimental setup (e.g., Haim & Graefe, 2017, Experiment 2).

We ended up with 12 studies included in the 11 articles (cf. Table 1).

2.3. Coding

For each experimental study, one author coded study artifacts that related to the study participants, the stimulus material, the experimental design, and the study results (cf. Table 1). If the coder was uncertain regarding a particular coding, the issue was resolved by discussion with the second author. The coding sheet is available at the Harvard Dataverse (Graefe, 2020).

2.3.1. Participants

We coded the number of participants, age and gender distribution, the country/region participants came from as well as how participants were recruited. Across the 12 experiments, a total of 4,473 people participated, of which 50% were female. The average age was 36 years. Participants were from the USA (all of which were recruited through Amazon Mechanical Turk), Germany (recruited through the Sosci Panel administered by the German Communication Association), South Korea, China, Singapore, and other European countries.

2.3.2. Stimulus

We coded the domain of the news article, the article topic, as well as the article language. Sports news were most often used (eight studies), followed by financial (six) and political (four) news. Two studies focused on breaking news (earthquake alerts), and one study each used texts within the domains of entertainment and other news. Six experiments used articled written in English, two each in German and Korean, and one each in Finnish and Chinese.

2.3.3. Study Design

Table 1 shows the design for each study, particularly regarding our key variables of interest, namely who the actual author of the article was, and who was declared as the author (author attribution). In addition, Table 1 also lists additional experimental manipulations if available.

2.3.4. Outcome Variables

Across the 12 experiments, credibility was measured most often (nine times), followed by quality (eight times) and readability (five times). While the specific operationalization of the three constructs somewhat varied across studies, the measures used intend to capture the same basic constructs. Also, 8 of the 12 experiments reported effect sizes on a 5-point scale, three studies used a 7-point scale, and one study used a 10-point scale. For each outcome variable, we coded mean ratings and standard errors and/or standard deviations.

2.3.5. Effect Size Calculation

For each experimental comparison of human-written and automated news, we calculated Cohen's d, the standardized mean difference between the two groups, as:

$$d = \frac{\overline{M}_{HW} - \overline{M}_A}{SD_{pooled}}$$

where $\overline{M}_{HW}$ refers to participants' mean rating for perceptions of human-written news and $\overline{M}_A$ refers to mean ratings of automated news (Cohen, 1988). Hence, positive values for d imply that the human-written were rated better than automated news, and vice versa. Meta-analysis effect sizes were calculated as weighted (by the inverse of the variance) averages across the d values for the available studies. When referring to magnitudes of effects sizes, we adopted the descriptors suggested by Cohen (1988) and refined by Sawilowsky (2009), namely, zero effect ($d = 0$), very small effect ($0 < d < 0.2$), small effect ($0.2 \leq d < 0.5$), medium effect ($0.5 \leq d < 0.8$), large effect ($0.8 \leq d < 1.2$) very large effect ($1.2 \leq d < 2.0$), and huge effect ($d \geq 2.0$).

2.4. Types of Evidence

We distinguish between experimental and descriptive evidence in our analysis.

2.4.1. Experimental Evidence

Experimental evidence aims to establish causal effects by isolating the effects of the independent variable (i.e., the author or the attribution) through experimental manipulation.

Studies that aim to isolate the effect of the article source would show all recipients the same text (either written by a human or an algorithm). However, for some recipients, the text would be declared as written by a human, whereas for other recipients, that very same text would be declared as automatically generated.

Studies that aim to analyze the effect of the content (i.e., the message) would present recipients with either a human-written or an automated text but would not reveal the source (i.e., the texts had no byline).

Table 1. Experiments included in the meta-analysis.

		Participants							Stimulus								Experimental design (J = journalist, A = algorithm, U = unknown)									Outcome variables			
#	Citation	Exp.	N	% female	Avg. age	Country	Recruited	Language	Sports	Politics	Finance	Entertainment	Breaking	Other	Topic(s)	Author Attribution	U J	U A	J J	J A	A J	A A	J U	A U	Credibility	Quality	Readability	N-point scale
1	Wu (2019)		370	50	NA	USA	Commercial online panel (Amazon Mechanical Turk)	English	X	X	X				Not specified	2 (attribution) × 2 (author) × 3 (topic)			X			X	X	X	X			10
2	Jia (2020)	2	308	67	24	China	Social media snowball sampling (Wechat, Weibo, and Zhihu)	Chinese	X	X				X	Soccer, Basketball, Travel, Company reports, Conferences	2 (author) × 4 (topic)							X	X	X	X	X	5
3	Haim and Graefe (2017)	1	313	61	36	Germany	Non-commercial online panel (SoSci Panel)	German	X		X	X			Soccer, Stocks, Celebrities	2 (author) × 3 (topic)			X			X			X	X	X	5
4	Zheng, Zhong, and Yang (2018)		246	53	40	USA (154) & China (91)	Commercial online panel (Amazon Mechanical Turk)	English	X	X			X		Basketball, Stocks, Earthquake	2 (attribution) × 2 (media outlet) × 2 (culture) × 3 (topic)	X	X							X	X		7
5	Graefe, Haim, Haarmann, and Brosius (2018)		986	53	38	Germany	Non-commercial online panel (SoSci Panel)	German	X		X				Soccer, Stocks	2 (author) × 2 (attribution) × 2 (topic)			X	X	X	X			X	X	X	5
6	Wölker and Powell (2018)		300	60	28	Europe	Social media snowball sampling (Facebook, Twitter, and LinkedIn)	English	X	X					Basketball, Business (Forbes)	single factor (author) with 4 groups			X			X			X			5

Table 1. (Cont.) Experiments included in the meta-analysis.

#	Citation	Exp.	N	% female	Avg. age	Country	Recruited	Language	Sports	Politics	Finance	Entertainment	Breaking	Other	Topic(s)	Author Attribution	U/J	U/A	J/J	J/A	A/J	A/A	J/U	A/U	Credibility	Quality	Readability	N-point scale
7a	Jung et al. (2017)	1	400	50	39	South Korea	Commercial online panel (Hankuk Research)	Korean (?)	X						Baseball	2 (author) × 2 (attribution)			X	X	X	X				X		5
7b		Pre-test	201	49	40	South Korea	Commercial online panel (Hankuk Research)	Korean (?)	X						Baseball	single factor (author) with two groups							X	X		X		5
8	Waddell (2018)		129	51	40	USA	Commercial online panel (Amazon Mechanical Turk)	English		X					Election polling	single factor (attribution) with 2 groups	X	X							X	X		7
9	Waddell (2019b)	1	612	47	38	USA	Commercial online panel (Amazon Mechanical Turk)	English		X					Khan Conflict, Paris Accord	3 (attribution) × 2 (media outlet) × 2 (topic)	X	X							X			7
10	Melin et al. (2018)		152	NA	NA	Finland	Commercial online panel	Finnish		X					Election results	single factor (author) with 4 groups					X	X	X	X	X	X	X	5
11	Tandoc et al. (2020)		420	41	38	Singapore	Commercial online panel	English					X		Earthquake	3 (attribution) × 2 (objectivity)	X	X							X			5
	Total		4,473	50	32	36			8	4	6	1	2	1			4	4	5	2	2	5	4	4	9	8	5	

2.4.2. Descriptive Evidence

Comparisons that provided descriptive evidence showed recipients news stories that were either written by a human or automatically generated, and truthfully declared the source. That is, human-written news would correctly be declared as written by a journalist, and automated news would correctly be labelled as generated by an algorithm. Then, the researchers would ask participants to rate these texts.

These comparisons do not allow for drawing causal inferences on the effects of the source or the message. However, for perceptions of credibility, researchers often use different scales (i.e., source credibility and message credibility), which were specifically designed to separate the effects. In contrast, no scales are available to distinguish the effects of the message and the source on perceived quality or readability. We were thus unable to separate the effects of source and message in these cases.

3. Findings

3.1. Main Effects

Figure 1 shows the main effects for each of the three constructs across all available comparisons, not differentiating between effects of the source and the message. Overall, there was no difference in how readers perceived the credibility of human-written and automated news ($d = 0.0$; SE = 0.02). Although human-written news were rated somewhat better than automated news with respect to quality, differences were small ($d = 0.5$;

SE = 0.03). In terms of readability, the results showed a huge effect in that readers clearly preferred human-written over automated news ($d = 2.8$; SE = 0.04).

Interestingly, however, the direction of the effects for credibility and quality differed depending on the type of evidence. For both credibility ($d = 0.3$; SE = 0.03) and quality ($d = 0.8$; SE = 0.03), experimental evidence favored human-written over automated news. In comparison, descriptive studies showed the opposite effect: Automated news were favored over human-written news for both credibility ($d = -0.5$; SE = 0.04) and quality ($d = -0.6$; SE = 0.06).

3.2. Credibility

Figure 2 distinguishes between comparisons that provide evidence on the effects of the source and the effects of the message.

3.2.1. Source Credibility

One factor that may affect readers' perception of news is the source or, more specifically, the author. Overall, the results show a small difference between readers' perceptions of source credibility: human-written news were rated somewhat higher than automated news ($d = 0.3$; SE = 0.04). That said, the direction of effects differed again depending on the type of evidence. While experimental evidence showed a medium-sized effect in favor of human-written news ($d = 0.5$; SE = 0.04), descriptive evidence revealed a small effect in favor of automated news ($d = -0.3$; SE = 0.08).
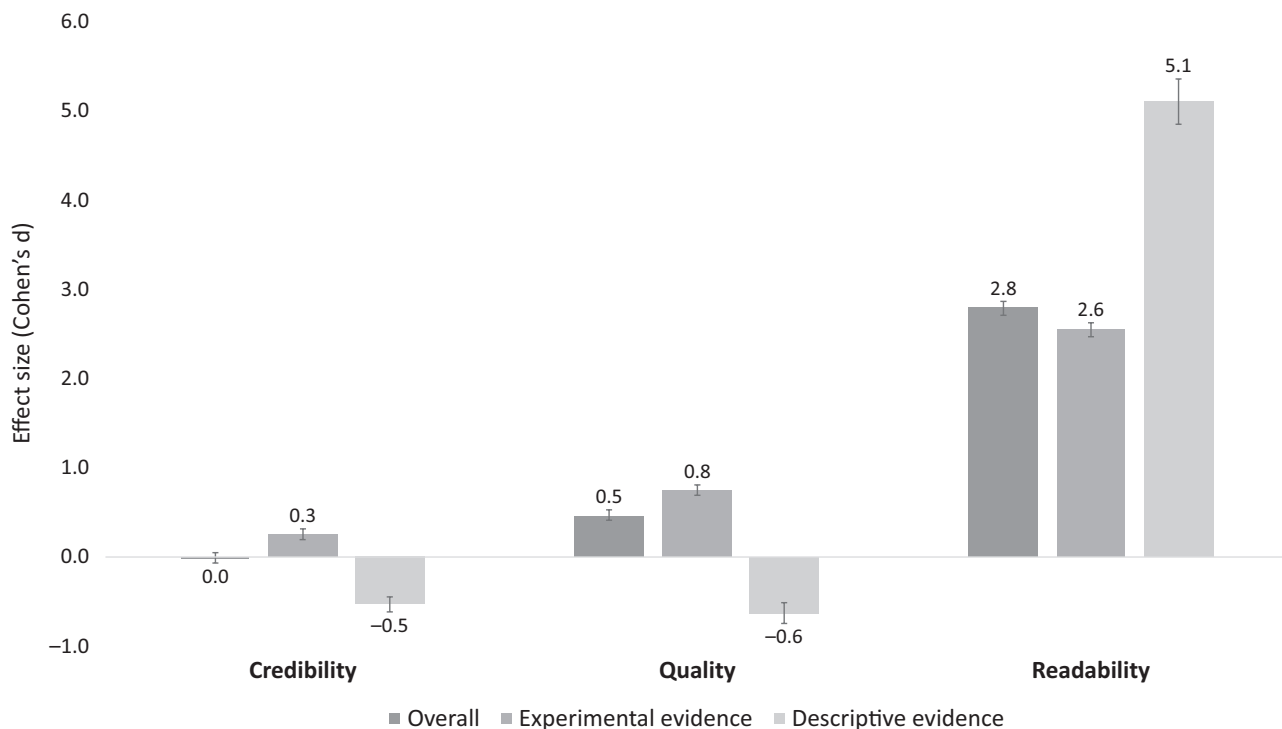

Figure 1. Main effects (standardized mean difference) for credibility, quality, and readability; by type of evidence. Note: Error bars show 95% confidence intervals.
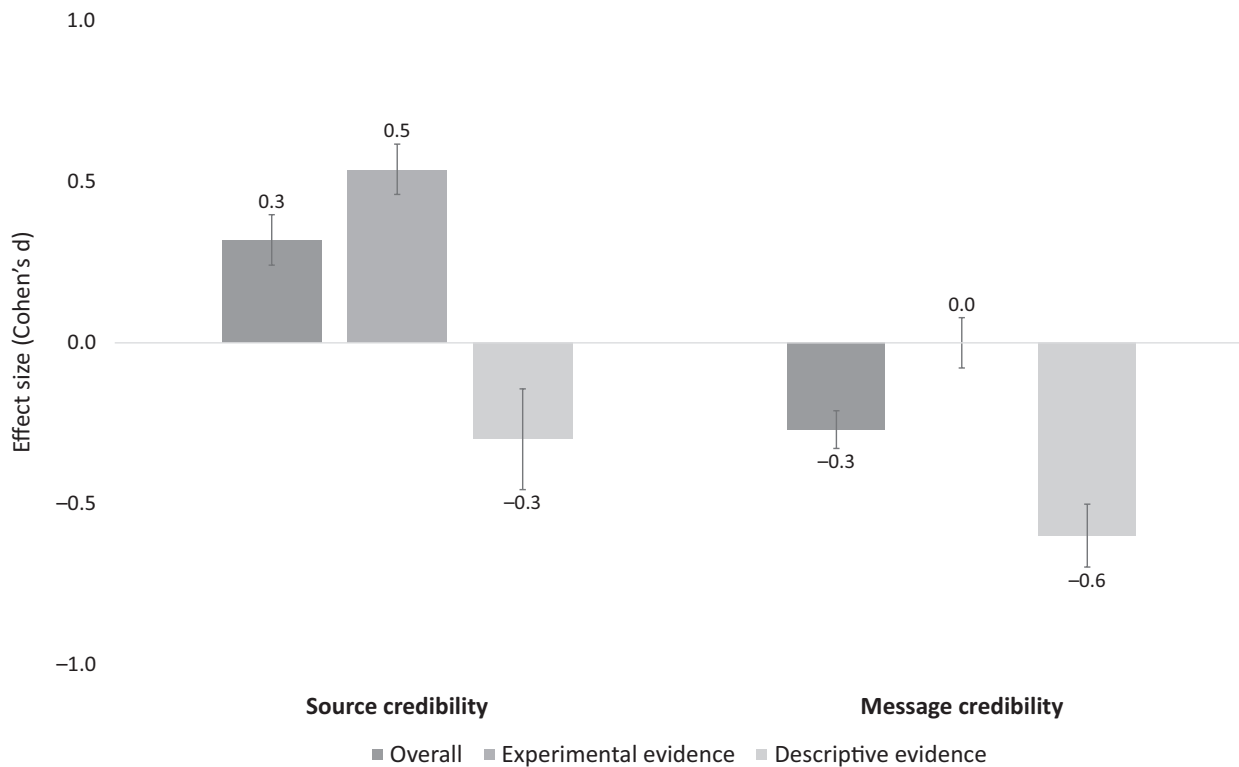
Figure 2. Standardized mean difference for credibility by type of evidence and effect. Note: Error bars show 95% confidence intervals.

3.2.2. Message Credibility

With respect to message credibility, automated news were rated somewhat more favorably across all comparisons ($d = -0.3$; SE = 0.03). Yet, again, the effect was solely carried by descriptive evidence ($d = -0.6$; SE = 0.05). Experimental evidence found no difference ($d = 0.0$; SE = 0.04).

3.3. Quality

Figure 3 distinguishes between experimental comparisons that provide evidence on the effects of the source and the effects of the message as well as descriptive evidence that does not allow for differentiating between effects of source and message on recipients' perceptions of quality.

Experimental evidence suggests that the article source has a small effect on perceptions of quality in that human-written news are rated somewhat better than automated news ($d = 0.3$; SE = 0.04). Experimental comparisons that provided evidence on the effects of the message found a very large effect in favor of human-written news ($d = 1.6$; SE = 0.05). Descriptive evidence, which does not allow for distinguishing between effects of the source and the message, found a medium-sized advantage for automated news with respect to perceived quality ($d = -0.6$; SE = 0.06).

3.4. Readability

Figure 4 distinguishes between experimental comparisons that provide evidence on the effects of the source and the message as well as descriptive evidence that does not allow for differentiating between effects of source and message on recipients' perceptions of readability.

Regardless of the type of evidence, the results showed a clear advantage for human-written articles. For experimental evidence on the effects of the source ($d = 1.8$; SE = 0.05) and the message ($d = 3.8$; SE = 0.07), effect sizes were very large and huge, respectively. Descriptive evidence on the combined effects of source and message showed a huge effect ($d = 5.1$; SE = 0.13).

4. Discussion

This meta-analysis aggregated available empirical evidence on readers' perception of the credibility, quality, and readability of automated news. Overall, the results showed zero difference in perceived credibility of human-written and automated news, a small advantage for human-written news with respect to perceived quality, and a huge advantage for human-written news with respect to readability.

One finding that stood out was the fact that the direction of effects differed depending on the type of evidence. Experimental evidence on the effects of the source found advantages for human-written news with
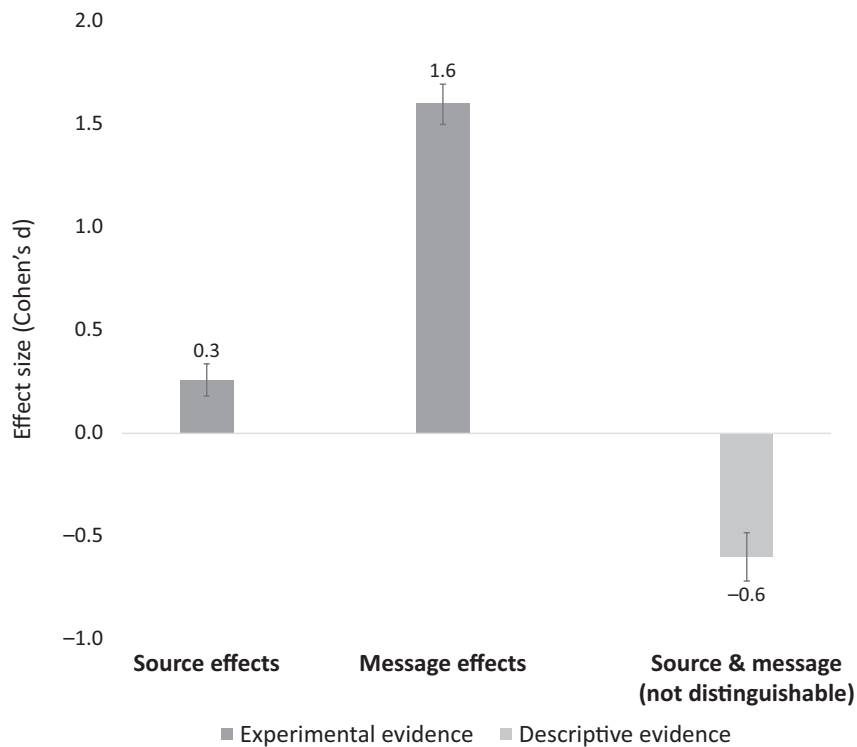
Figure 3. Standardized mean difference for quality by type of evidence and effect. Note: Error bars show 95% confidence intervals.

respect to quality (small effect), credibility (medium-sized), and readability (very large). In other words, regardless of the actual source, participants assigned higher ratings simply if they *thought* that they read a human-written article. The results thus support the

authority heuristic and the social presence heuristic, while contradicting the machine heuristic (Sundar, 2008). Given these findings, news organizations may worry that their readers would disapprove of automated news and therefore refrain from disclosing that a story was auto-
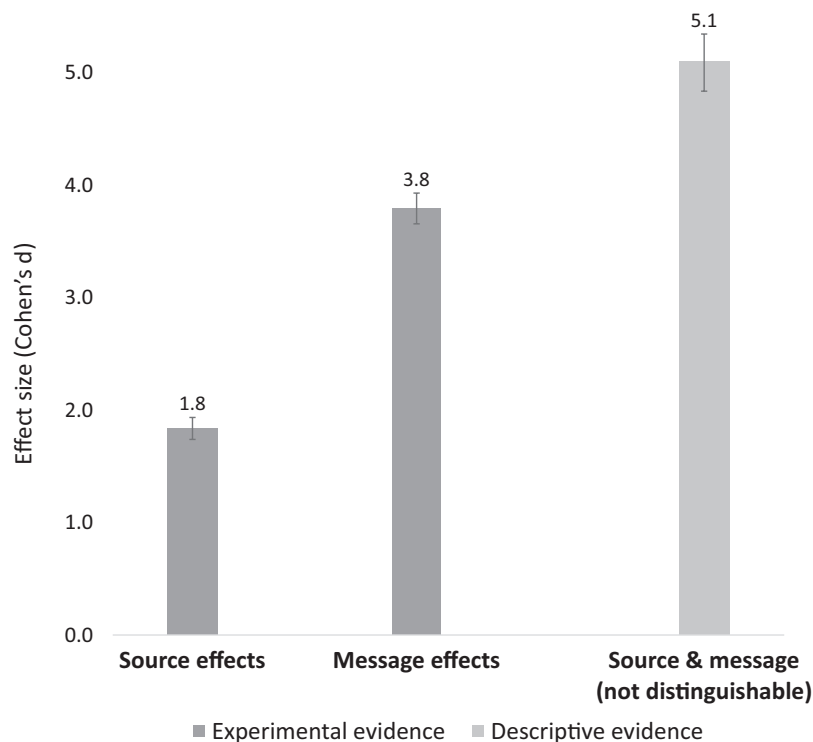

Figure 4. Standardized mean difference for readability by type of evidence and effect. Note: Error bars show 95% confidence intervals.

matically generated (e.g., by not providing a byline). This underscores the ethical challenges that arise from automated journalism (Dörr & Hollnbuchner, 2017).

Experimental evidence further showed advantages for human-written news with respect to the effect of the message (i.e., the article content). If participants did not know what they were reading, they assigned higher ratings to human-written news compared to automated news with respect to quality (very large effect) and readability (huge effect). There was, however, no effect for credibility. Obviously, these results depend entirely on the actual articles used in these comparisons. We thus refrain from deriving any conclusions or practical implications from these results and expect that the human written articles in these particular comparisons may have simply been better than the automated counterparts. The extent to which these articles are representative of the relative quality of automated and human-written news at the time is unclear.

In contrast, descriptive evidence showed opposite results with respect to how article source and message affect perceptions of credibility and quality. That is, automated news were perceived as more credible and of higher quality than the human-written counterparts in studies that asked recipients to evaluate articles whose source was truthfully declared. Given that these studies do not allow for making causal inferences, it is difficult to draw practical implications. In particular, any differences in effect sizes could simply be due to differences in the actual quality of the articles themselves.

Our analysis thus demonstrates the importance of distinguishing between the type of evidence (descriptive vs. experimental) as well as the origin of the effect (source and message). Otherwise, interesting findings, such as the positive effect of human authors on people's perceptions may get lost in the aggregate. That said, effects of the source with respect to both perceived credibility and quality were small. News organizations may not need to worry too much that readers could perceive automated news as less credible, or more generally as being of lower quality, than human-written news—assuming of course that the articles' actual quality is similar.

Differences with respect to readability, however, were huge. On the one hand, one could assume that poor readability is a critical barrier for readers' willingness to consume automated news. On the other hand, it should be noted that automation is most useful for routine and repetitive tasks, for which one needs to write a large number of stories (e.g., weather reports, corporate earnings stories). Such routine writing is often little more than a simple recitation of facts that neither requires flowery narration nor storytelling. In fact, in certain domains such as financial news, sophisticated writing may even be harmful, as consumers generally want the hard facts as quickly and clearly as possible. Another potential benefit of automation is the possibility to cover topics for very small target groups, for which previously no news were available (e.g., lower league games for niche sports, earthquake alerts, fine dust monitoring, etc.). For such topics, readers may be happy if they get any news at all. As a result, they may not be too concerned with readability, especially with how the construct is commonly measured (e.g., with items such as 'entertaining,' 'interesting,' 'vivid,' or 'well written') in the literature. Future research should analyze perceptions of readers that represent the actual target group (i.e., people who would actually consume automated news).

Needless to say, our results provide merely a snapshot of the current state of news automation, drawing on evidence from 11 articles published between 2017 and 2020. Readers' perceptions may change over time, and they may change fast. Assuming that automated news becomes more common, readers would get more accustomed to such content, which could ultimately affect their perceptions. Also, the technology for creating automated news, as well as the availability of data, is likely to further improve over time, which we expect to positively affect both the quality and readability of automated news. Advances in statistical analysis, in combination with more data, should make it possible to add more context (e.g., adding weather data to exit polling texts) and analytical depth (e.g., by analyzing historical data, making predictions, etc.), which should improve the perceived quality of such texts. Similarly, we would expect natural language generation to further improve, with positive effects on perceived readability. Future research should continue monitoring readers' perception of automated news, especially if and how improvements in the objective quality of the texts affect their perceived quality.

The latter relationship has generally been overlooked in research to date. Available studies have merely analyzed if, and to what extent, readers' perceptions of automated and human-written news differ. Yet, we do not know which factors drive these perceptions. What is it that makes an article perceived as more or less credible or readable? Such information would be valuable for developers of automated news to improve the (perceived) quality of the texts.

Conflict of Interests

The authors declare no conflict of interests.

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