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MACHINE AUTHORSHIP *IN SITU*

Effect of news organization and news genre on news credibility

Bingjie Liu and Lewen Wei

News-writing bots have been applied in news production. However, findings remain equivocal about how machine authorship is received by readers. To understand the inconsistency in past findings, this study conducted a 2 (purported writer: human vs. machine) \times 2 (news organization: the New York Times vs. Fox News) \times 2 (news type: spot news vs. interpretive news) between-subjects online experiment ($N=355$) to examine how the identity of news writers, human vs. machine, would impact the processing and evaluation of the news writer and the news as context varies. Findings suggest that machine-written news induced less emotional involvement and was perceived as more objective. However, machine writer was perceived as of less expertise compared with its human counterpart. On the selected issues (Obamacare, LGBT rights, and refugee admission), news purported to be released by Fox News was less trusted by the participants than the New York Times. For a media organization whose news was more trusted, utilizing news-writing bots enhanced perceived news objectivity. Otherwise, employing bots further reduced perception of the writer's trustworthiness and expertise. Furthermore, machine authorship enhanced perceived news credibility more prominently when writing a genre that demanded more information processing. Theoretical and practical implications are discussed.

KEYWORDS automated journalism; credibility; interpretive news; machine heuristic; mind perception; news organization

Introduction

More than two decades ago, research found people reluctant to have machine (e.g., computer) take jobs that required interpretation such as news writing (Nass et al. 1995). Yet today, with improved natural language processing and machine learning techniques, computer-based algorithms used in news production, i.e., news-writing bots, have already become reality (Clerwall 2014; Dalen 2012). For instance, *The Los Angeles Times* published an algorithm-written news article about an earthquake in California right after its happening (Marshall 2013). Such machine writers now produce thousands of articles every day for a variety of news outlets on various topics (Graefe 2016).

Even though the quality of machine-written news is not necessarily worse than that by journalists (Clerwall 2014; Dalen 2012), readers' processing and evaluations of

machine-written news might be affected by their assumptions about machine's ontological status and capacities. On one hand, as the public tends to think of machine as free of intentions and biases (Kim and Sundar 2016; Minsky 2006; Sundar 2008), machine-written news is often considered as more objective (Clerwall 2014), and induces less emotional involvement among readers while reading the news (Liu and Wei 2018). On the other hand, machine's capacity in conducting interpretive tasks remains doubtful as two decades ago (Gambino and Sundar 2017; Nass et al. 1995).

Among the plethora of research on the effect of machine authorship, an important question is rarely visited, that is, how the contexts might interact with the widely held ontological assumptions about machines and influence how readers process and evaluate machine-written news. News-writing machines do not write in vacuum. Instead, they are utilized by news organizations in writing news varying in length, style, and depth. Readers' attitudes to different news organizations owning the news-writing machine in a given domain (Carroll 2017), along with preconceptions of machine's capability in writing content demanding different cognitive skills, might impact how people process and evaluate machine-written news. As suggested in the research agenda proposed by Lewis and Westlund (2015), to better understand institutional news production with technology involved, researchers should consider the interplay among human actors, technological actants, audiences, and the activities of news production and interpretation (4As) from a holistic perspective. However, research thus far has not yet examined the effect of machine authorship *in situ*. To bridge this gap, this study aims to examine the interaction effect of machine authorship and news context on how general readers react to machine-written news.

Literature Review

Automated journalism is the practice of using algorithms to automatically generate news stories from raw data without or with little human intervention (Carlson 2015; Latar 2015; Napoli 2014), which have been labeled as automated news (Haim and Graefe 2017), computer-generated news (Graefe et al. 2016), algorithm-written news (Gambino and Kim 2015), and robot-written news (Carlson 2015; Clerwall 2014; Waddell 2018), etc. Regardless of how researchers have labeled such practice, these news generators are constantly juxtaposed and compared with human writers specifically on the dimension of "mental" capacity. Despite the variance within the category of machines, past research has revealed that laypersons hold certain common beliefs regarding machine's capacity. In the following sections, we will discuss existing findings on the common assumptions people hold for machine and effect of machine authorship on processing and evaluating machine-written news and discuss how readers might process and judge news of different types written by machines affiliated with different news organizations.

Construal of Machine's Mental Capacity

Research thus far has found that reduced interpersonal similarity leads to declining mind perception (Waytz et al. 2010) so that compared to in-group members, out-group members induce less activation in the medial prefrontal cortex, a brain region involved in perceiving other minds (Harris and Fiske 2006). For example, evidence shows

that people tend to judge others' rationality based on the extent to which their political beliefs align. That is, the more different their political beliefs are, the more likely others will be perceived as lacking an objective perspective and the ability to conduct logical analysis (Kennedy and Pronin 2008). Thus, out-group members are often attributed with diminished mental capacities just like animals (Goff et al. 2008; Viki et al. 2006).

Compared with its human counterpart, machine, as an out-group member is perceived as of less mind (Gray and Wegner 2012). As found in Gray, Gray, and Wegner (2007), individuals rate social robots as of little experience and feelings, and only of moderate level of agency in terms of the ability to think and act relative to human actors. By showing the mechanical aspect of a humanoid robot (i.e., the circuit in its head), participants' mind perception of the robot was significantly reduced compared with when seeing it from the front side where the anthropomorphic features were visible (Gray and Wegner 2012).

Consistent with this common assumption that machine is of less mental capacity, a commonly held heuristic, i.e., mental shortcuts or rules of thumb developed from experience (Bellur and Sundar 2014; Chen and Chaiken 1999), about technological artifacts is that they are free of intention and bias, and therefore, objective (Sundar 2008). Past research has supported this notion such that news stories purported to be selected by a computer were evaluated as of higher quality than the very same news purported to be selected by news editors because "if a machine chose a story, it must be truly random and hence representative of news" (Sundar and Nass 2001, 68). When booking a flight, people were also more willing to disclose their credit card information to Siri (a virtual agent embedded in Apple products) than to a human service agent, because Siri, as a machine, was believed to have no malicious intentions (Kim and Sundar 2016).

In terms of news production in this digital age, compared with traditional journalism, digital journalism embraces more diverse content format and styles, challenging the conventional objective storytelling style by including more emotional and personalized forms of narratives, which is expected to encourage more engagement among the audiences (Papacharissi and de Fatima Oliveira 2012; Wahl-Jorgensen 2016). However, what if the news is regarded as being composed by a machine? As findings in past research suggest, the decrease in mind perception of an agent reduces the perceived meaningfulness of its activity (Waytz et al. 2010) and induces less emotional involvement from individuals interacting with it (Reeder and Trafimow 2005). In this sense, machine-written news should induce less emotional involvement among readers as a result of the lack of mind attribution to machine. In support of this corollary, a recent study found identical news about climate change purported to be written by a news bot induced less emotional involvement (Liu and Wei 2018). Therefore, we hypothesize that machine-written news will induce less emotional involvement than human-written news.

H1: Machine-written news will induce less emotional involvement from readers than human-written news.

Perception of Machine-Written News

When it comes to evaluating machine-written news, besides the content itself, the general assumptions people hold about machine's capacities may make a

difference as well. As cognitive misers, people do not process all the information available comprehensively (Fiske and Taylor 1984). Instead, they may simply be swayed by peripheral cues such as number of endorsers, number of arguments, source attractiveness and credibility, etc. (Petty and Cacioppo 1986). These peripheral cues trigger related heuristics (Bellur and Sundar 2014; Chen and Chaiken 1999; Kruglanski and Thompson 1999), which drive individuals' judgment making. Therefore, although the focus should be on the content when making judgements on the quality and credibility of machine-written news, source attributes will also play a role as suggested by past research (e.g., Arpan and Raney 2003; Bakker et al. 2013; Messing and Westwood 2014).

As discussed earlier, relative to human beings, machines are often perceived as of less mental capacity in terms of both internal experiential state and agency (Gray, Gray, and Wegner 2007). News writing as an intellectual, interpretive task that is traditionally deemed unique to human beings, when carried out by a machine, might be viewed with a wary eye. As found in past research, people do not trust computers to take interpretive jobs such as journalists and novel writers (Nass et al. 1995) and a most recent replication of this study found similar results (Gambino and Sundar 2017). When readers are exposed to machine-written news, their processing of the news might be impacted by such a heuristic regarding machine's capacity triggered by the cue of machine identity.

Research on readers' perception of machine-written news has been conducted following two methodological paradigms. The first one focuses on content of the news by comparing news *actually* generated by machines with a similar piece of news written by human journalists on the same topic. For example, Clerwall (2014) presented participants with two news articles on the same topic with one generated by a software and the other written by a journalist. Although participants were not able to distinguish them, software-generated content was perceived as more descriptive and boring, but also more objective compared to that written by a journalist. Another study presented participants with news articles on sports and finance either written by a human or a computer (Graefe et al. 2016). They found computer-written news was rated as more credible and of higher journalistic expertise, but less readable. In addition, Haim and Graefe (2017) found readers preferred human-written news for readability but favored machine-written news for credibility when two pieces of news were presented together.

However, studies following this paradigm confound the effect of news content and that of news source because news content varies together with news source. Therefore, differences between machine-written news and human-written news found in those studies cannot be completely attributed to machine authorship. In order to understand the effect of machine authorship rather than the content variance, many other studies followed the second paradigm by comparing news with identical content but purported to be written either by human or by machine (e.g., Gambino and Kim 2015; Graefe et al. 2016; Haim and Graefe 2017; Waddell 2018).

Research following the second paradigm yields mixed findings. Some studies presented evidence for people's preferences for machine authorship. For example, Graefe et al. (2016) found that regardless of the actual sources, news declared to be generated by an algorithm was rated lower on credibility and readability than that purported to be written by a journalist. Other studies also found that machine-written news was

evaluated as less trustworthy (van der Kaa and Krahmer 2014) and less credible (Waddell 2018). However, Gambino and Kim (2015) found that a short piece of news on finance purported to be written by a news bot was more trusted than that written by a human journalist, whereas for a longer piece of health news, that written by human was preferred over that by the news bot (Gambino and Kim 2015).

When interpreting these mixed findings, we noticed that thus far, most research on machine-generated content treats both “machine” and “content” as constants without considering the variance within each of them. However, machine does not write in vacuum. Studies following either paradigm have situated content generators in different contexts. For example, the news stimuli varied in terms of topics (health, finance, politics in Gambino and Kim 2015; Climate change in Liu and Wei 2018; Election poll in Waddell 2018), length (Gambino and Kim 2015; Liu and Wei 2018), genres (factual match report vs. opinion, in Clerwall 2014) and were embedded in various news organizations (e.g., *the New York Times* in Gambino and Kim 2015; *USA Today*, Waddell 2018). These contextual factors, may serve as cues themselves, and may or may not be compatible with the commonly held assumptions about machine’s capacities, which may have different implications on processing and evaluating machine-written news. Therefore, impact of different news organizations and news types should be taken into account by researchers in order to understand how machine-written news is received by media consumers *in situ*.

Effect of Institutional Source

As Lewis and Westlund (2015) argued, the impact of robot journalism in institutional news production should be considered from a holistic view with the interplay of editorial, business, and technology taken into account. News content is produced consistent with and reflects its institutions’ stances and goals. Thus, the credibility of the news organization on certain news topics will influence how readers judge the credibility of the news content it produces. Especially for controversial news issues, readers, in particular those who are personally involved with the issues, tend to perceive news content released by organizations on their rival side as biased against their own stance and therefore, lack of credibility, as characterized by the phenomenon of “hostile media effect” (Cho and Boster 2005; Choi, Watt, and Lynch 2006; Gunther and Liebhart 2006). For example, as found in a study by Arpan and Raney (2003), football fans perceived news purported to be published on the newspaper of their rival university’s town as more biased compared to that published on their hometown and neutral-town newspapers because the rival’s town’s newspaper was regarded as more motivated to report in favor of their own university team. Therefore, media consumers’ trust in the news organizations on reporting certain domains of news should be taken into account when examining how machine-written news is processed and evaluated.

So far, most machines are not advanced to the point where it can hire itself to assemble resources for news production. Instead, they are owned, developed, tweaked, and used by individuals or organizations. News organizations set goals and rules for its news-writing algorithms (Marshall 2013), hence, it is the organization designing and owning the machine being regarded as the locus of agency and responsibility (Wegner

and Gray 2017). Arguably, the trustworthiness of the news organization might influence how readers react to the news content generated by their machines.

Since machine is perceived as of less agency than human beings (Gray, Gray, and Wegner 2007), a corollary follows that compared with human writers, machine writers might be more subject to intervention from the news organizations so that the generated content will be more in line with the values and goals of the organizations. Therefore, machine-written news should be less trusted than human-written news when utilized by untrusted news organizations in that for organizations, it should be easier to manipulate machines than to socialize its journalists and editors who possess more agency as human beings.

Nevertheless, it is also plausible that as machine is believed to be neutral and objective (Sundar 2008), machine authorship will mitigate the doubts on the less trusted news organizations. The joint effect of the distant source (media organization) cue and the proximate source (author of the article) cue depends on which heuristics are triggered in the course of information processing. Existing research on machine-written news has not investigated the potential impact of the institutional layer. Therefore, besides evaluations of the objectivity and credibility of the news content, we are also interested in how the proximate source, i.e., the news writers, are perceived differently in terms of their trustworthiness or “good will” (McCroskey and Teven 1999) and expertise when they are machines. Will they be perceived as especially less credible when utilized by incredible media organization? Or, will they be perceived as objective regardless? In light of the two possibilities, we propose two competing hypotheses and one research question:

H2A: Institutional source of news moderates the relationship between news writer identity and readers’ perceptions. Specifically, for a less trusted media institution, machine-written news will be more negatively judged than human-written news in terms of (a) news objectivity, (b) news credibility, (c) writer’s trustworthiness, and (d) writer’s expertise.

H2B: Institutional source of news does not moderate the relationship between news writer identity and readers’ perceptions such that machine-written news will be judged as more objective than human-written news, regardless of the credibility of media institutions.

RQ1: Will machine-written news be more positively judged in terms of (a) news credibility, (b) writer’s trustworthiness, and (c) writer’s expertise?

Effect of Level of Interpretation in News

Existing research on automated news mainly focuses on whether machine can emulate journalists’ general performance in news writing, without looking into specific categories of news writing, such as what type of news is perceived as suitable for machine to write. In journalistic practice, news is often divided into two types, namely spot news (or hard news) and interpretive news (or feature story, soft news, DeMott 1973). They differ on dimensions such as timeliness (Shoemaker and Cohen 2006), topic, focus, and style (Reinemann et al. 2012). Compared with spot news that is usually shorter, more structured and formularized, with less interpretation but with more focus on factual information, interpretive news writing is more demanding in terms of

writer's cognitive capabilities in terms of information processing, interpretation, and writing skills (Boczkowski and Peer 2008; Patterson 2000; Reinemann et al. 2012).

In light of the widely held assumption about machine's capacity that machine lacks the ability for interpretive tasks (e.g., Nass et al. 1995; Gambino and Sundar 2017), news type that demands different level of interpretative skills is expected to play a role in how readers perceive machine-written news, and there are two possibilities as implied by different theories. First, one's preconceptions of machine writer's capacity such that machine is inadequate in conducting interpretive work might carry over when they process and evaluate the news content. Research has found that most readers do not spend much cognitive effort when consuming online news and heavily rely on cues and heuristics triggered to make judgements about the news content (Metzger and Flanagin 2013; Metzger, Flanagin, and Medders 2010; Sundar, Knobloch-Westerwick, and Hastall 2007). In this case, the final judgement will be driven by the valence of the cues regardless of the quality of the content (Petty and Cacioppo 1986). Therefore, news content generated by a positive source is expected to be always judged more positively than that by a negative source regardless of the news content.

Specifically, for hard news that is mainly fact-based and requires little interpretation from the writers, machines might be regarded as capable enough in conducting such a simple task as its human counterparts are. But when it comes to a news type that demands more interpretation, machine might be perceived as incompetent and therefore less trusted because of its incapability in doing more interpretive work (Nass et al. 1995). Therefore, when juxtaposed in the domain of writing interpretive news (vs. spot news), machine should be less trusted than its human counterpart. For example, Gambino and Kim (2015) found machine-written news was more trusted than human writer in writing a short finance news with mainly factual information but was less trusted when it was a longer news article on health. Although they interpreted this finding as it was due to the topic difference such that health topic is more pertain to humanity whereas the finance news is more number-based, which is typically regarded as the domain of a machine, the topic effect is confounded with the level of demandingness of the news writing task.

Alternatively, as suggested by expectancy violations theory (EVT, Burgoon 2016; Burgoon and Hale 1988), exposure to the news content might confirm or violate readers' prior expectation for machine as news writer, which further influences their perceptions about the writer and the news content. According to EVT (Burgoon 2016), a positive expectancy violation (i.e., actual performance superior to prior expectation) results in positive attitudes whereas a negative expectancy violation (i.e., performance inferior to prior expectation) leads to negative attitudes. Although EVT was initially proposed to explain interpersonal communication phenomena, its proposition regarding the effect of expectancy violation valence on attitudes has been tested and supported in many other areas including technology use (Kalman and Rafaeli 2011; Ramirez and Wang 2008; Sundar, Dou, and Lee 2013).

In this regard, if the quality of the news content exceeds reader's prior expectations, it will be more highly evaluated. Otherwise, it will be more negatively judged if it fails to meet readers' expectations. For example, Waddell (2018) found that news written by an algorithm was less trusted than that written by a human writer because readers' presumption on machine's objectivity was negatively violated. As machine is expected to be inferior in the domain of interpretive work such as news writing (Nass et al. 1995; Gambino and Sundar 2017), interpretive news written by machine is

expected to positively violate people's expectation for machine's capacity, and results in more positive attitudes as compared with writing fact-based hard news, which is less demanding than interpretive news and is therefore less likely to impress the readers.

Given the different possibilities outlined above regarding how news type that demands different levels of interpretive work might moderate the relationship between news writer identity and readers' perceptions, we proposed the following competing hypotheses:

H3A: News type moderates the relationship between news writer identity and readers' perceptions. Specifically, for spot news, machine-written news will be more positively judged than its human counterpart in terms of (a) news objectivity, (b) news credibility, (c) writer's trustworthiness, and (d) writer's expertise but will be more negatively judged for interpretive news.

H3B: News type moderates the relationship between news writer identity and readers' perceptions. Specifically, for interpretive news, machine-written news will be more positively judged than its human counterpart in terms of (a) news objectivity, (b) news credibility, (c) writer's trustworthiness, and (d) writer's expertise.

Method

Study Design

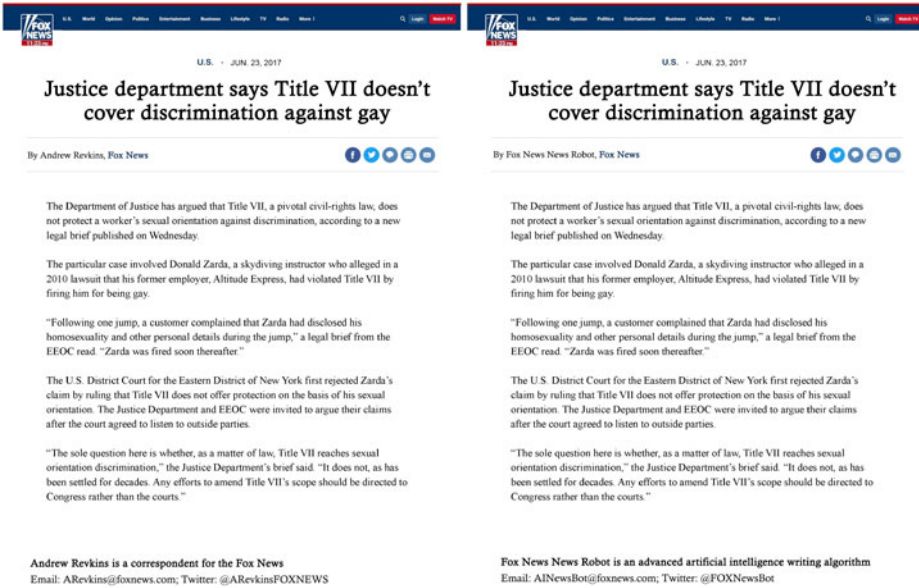
We conducted a 2 (purported writer: human vs. machine) \times 2 (news organization: *the New York Times* vs. *Fox News*) \times 2 (news type: spot news vs. interpretive news) between-subjects online experiment. To enhance external validity, in each condition, participants read news on one of the three topics (Obamacare, LGBT rights, and refugee admission) randomly, resulting in 24 different stimuli varying in terms of writer identity, organizational source, news genre, and news topics.

Prior to reading the news stimuli, participants first completed a set of questions inquiring into their political value, and involvement with three news issues (Obamacare, LGBT rights, and refugee admission). After that, they were randomly assigned to read one of the 24 news articles. Then, they were directed to complete another set of questions assessing their emotional involvement, perceptions towards the news article and the news writer, and their demographics. Upon successful completion of the whole study, each participant was rewarded with \$0.25 as compensation.

Participants

We had 573 participants located in United States recruited from the Amazon Mechanical Turk. We removed participants who failed in correctly identifying the topic, writer identity, and organizational source of the news article, and those who failed the attention check. The final dataset consists of 355 participants.

Among them ($N = 355$), there were 180 female participants and 172 male participants, with 3 who indicated "other." Age ranged from 18 to 77 ($M = 39.35$, $SD = 12.61$). The majority of the participants (76.90%) identified themselves as Caucasian and 60.1% have obtained the Bachelor's degree or higher. Participants' political value conforms to a normal distribution ($M = 3.39$, $SD = 1.87$, Skewness = .34, Kurtosis = -.97).

**FIGURE 1**

Spot news purported to be written by human writer and AI affiliated with *Fox News*

Stimuli

To enhance external validity, three topics were chosen, namely Obamacare ($n = 121$), LGBT rights ($n = 117$), and refugee admission ($n = 117$), covering the domains of health, ethics, and international politics. The news contents were aggregated and adapted from existing news reports on mainstream media websites such as *CNN.com*, *businessinsider.com*, *observer.com*, etc., and information and opinions endorsing both sides were included to generate relatively balanced news articles.

We created the templates for all the stimuli based on the current website interfaces of *Fox News* (Fox) and *the New York Times* (NYT). According to the Pew Research Center (2016), NYT is considered as politically liberal and Fox is considered as politically conservative in United States. On the three selected topics, the two media organizations should hold opposite standings and therefore being trusted differently by participants.

To manipulate the identity of news reporter, as shown in Figure 1, we highlighted the identity of the author at three places on each screenshot of a news article—reporter's name, brief description of the reporter, and contact information. For the human reporter, we made up a name "Andrew Revkins," description about him, and his contact information. The machine reporter was labeled as "Fox News Robot" or "the New York Times News Robot." We then introduced the machine reporter as an advanced artificial intelligence (AI) writing algorithm, and its email address and Twitter account were adapted accordingly.

We manipulated news type by varying the amount of interpretation in the news articles to match the difference between typical spot news and interpretive news, which differ from each other in (a) level of interpretation and (b) length. Since

hypotheses derived in the current study were not based on writing style, we did not vary the linguistic style of the news article across conditions. Spot news articles consist of 200–270 words and were composed with mainly factual information. High-interpretation news articles, instead, consist 600–800 words, and include more elaborations and interpretations in addition to each piece of factual information. For example, in covering the LGBT rights story, low-interpretation news reported that fact that the U.S. District Court for the Eastern District of New York rejected the claim by Donald Zarda who claimed himself was fired for being homosexual according to the Title VII, whereas high-interpretation news added more reasoning and explanations on why it happened by discussing the content in the Title VII and explaining why it did not offer protection discrimination based on sexual orientation.

Measurement

Unless indicated specifically, all items were measured on a seven-point scale.

Manipulation Check

Participants were asked to answer the question “The news you just read was written by” and choose among “human,” “robot,” and “I don’t know.” Only those who answered this question correctly were remained for further data analyses.

Level of Interpretation

Participants were asked to rate the level of interpretation of the stimuli content with six items created by the researchers, including “sophisticated,” “deep,” “interpretative,” “thoughtful,” “meaningful,” and “analytical.” We combined the six items to form an index, which was reliable ($M = 3.80$, $SD = 1.37$, Cronbach’s $\alpha = .91$).

Individual Differences

Issue involvement was measured with the adapted value-relevant involvement scale developed by Cho and Boster (2005). Sample items include “The values that are the most important to me determine my stand on this issue” ($M = 4.59$, $SD = 1.41$, Cronbach’s $\alpha = .94$).

Political value was measured by asking participants “How much do you identify with values that are” with “liberal” being “1” and “conservative” being “7” on a one to seven continuum ($M = 3.39$, $SD = 1.87$).

Perceptual Dependent Variables

Emotional involvement was measured with three items adapted from study by Matthes (2013) with an emphasis on one’s involvement during reading the news article. Participants were asked to indicate their agreement with the following statements, “Reading this news aroused my feelings,” “I emotionally reacted to the issue while reading,” and “I felt really emotionally involved while reading this news” ($M = 4.05$, $SD = 1.73$, Cronbach’s $\alpha = .96$).

Objectivity

Objectivity is typically measured as one item in news credibility index (Meyer 1988). To create a scale for objectivity, we adopted five items capturing “objectivity” in professional journalism (Donsbach and Klett 1993; Gaziano and McGrath 1986; Meyer 1988; Thomson, White, and Kitley 2008; Wien 2005). We asked participants “how much do you think this news is” on the following five dimensions, “Imbalanced – Balanced,” “Not impartial – Impartial,” “Not objective – Objective,” “Sided – Neutral,” and “Biased – Unbiased” and combined the five items to form an index, which was reliable ($M = 4.31$, $SD = 1.60$, Cronbach’s $\alpha = .93$).

News Credibility

We adopted the news credibility measure from Appelman and Sundar (2016)’s study. Participants were asked to answer questions “How much do you think the news you just read is, (a) accurate, (b) authentic, and (c) believable,” respectively, ($M = 4.79$, $SD = 1.56$, Cronbach’s $\alpha = .96$).

Writer’s Trustworthiness

Writer’s trustworthiness was measured with five items adapted from McCroskey and Teven (1999) and Ohanian (1990) that are applicable to both the human writer and the machine writer. For the human writer, we asked participants “what do you think of the news writer on the following dimensions?” For the machine writer, we asked participants “What do you think of the news bot (algorithm) on the following dimensions?” Sample word pairs include “Undependable – Dependable” and “Dishonest – Honest,” etc. ($M = 4.69$, $SD = 1.37$, Cronbach’s $\alpha = .93$; Cronbach’s α for the human condition = .94; Cronbach’s α for the machine condition = .92). Writer’s expertise.

Writer’s Expertise

Writer’s expertise was measured with ten items adapted from McCroskey and Teven (1999) and Ohanian (1990) that are applicable to both the human writer and the machine writer. Sample word pairs include “Inexpert – Expert,” “Inexperienced – Experienced,” “Not knowledgeable – Knowledgeable” ($M = 4.91$, $SD = 1.31$, Cronbach’s $\alpha = .96$; Cronbach’s α for the human condition = .96; Cronbach’s α for the machine condition = .96).

Results

Manipulation Check

After checking our manipulations on news writer identity, news organization, and news type, 95 participants failed to identify the correct identity of the news writer, 85 failed in identifying news organization, and 56 failed in identifying news topic, among whom, 18 participants failed multiple manipulation checks. After removing these cases, responses from a total of 355 participants were kept for the following analyses.

Across all the conditions, interpretive news was perceived as of higher level of interpretation ($M = 4.03$, $SE = .09$) than spot news ($M = 3.57$, $SE = .11$), $t(353) = 3.23$, $p < 0.001$ (two-tailed).

TABLE 1
Correlations among dependent variables and covariates

	1	2	3	4	5	6	7
1 Emotional involvement	—						
2 Perceived objectivity	.08	—					
3 News credibility	.14**	.52***	—				
4 Writer's trustworthiness	.10	.55***	.69***	—			
5 Writer's expertise	.14**	.50***	.68***	.88***	—		
6 Political value	-.17***	-.09	-.02	.01	.01	—	
7 Issue involvement	.47***	.11*	.04	.06	.09	-.21***	—

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

On the selected issues, Obamacare, LGBT rights, and refugee admission, credibility of news purported to be released by NYT ($M = 5.07$, $SE = .11$) was perceived as higher than that by Fox ($M = 4.52$, $SE = .12$), $t(353) = 3.43$, $p < 0.001$ (two-tailed). Trust in the authors of NYT ($M = 4.86$, $SE = .10$) was also perceived as higher than that of Fox ($M = 4.52$, $SE = .11$), $t(353) = 2.39$, $p < 0.01$ (two-tailed). Perceived expertise of NYT authors ($M = 5.01$, $SE = .09$) was also higher than that of Fox ($M = 4.58$, $SE = .10$), $t(353) = 3.18$, $p < 0.001$ (two-tailed). Therefore, Fox was considered as a proxy for a less trusted news organization while NYT was considered as a proxy for a more trusted news organization in the current study.

Effects of Machine Authorship, News Organization, and News Interpretation

To test the effect of news writer identity, news organization, and news type, we conducted a series of univariate analyses of covariance (ANCOVA) with emotional involvement, perceived objectivity, news credibility, writer's trustworthiness, and writer's expertise as dependent variables respectively, controlling for individuals' political value and issue involvement. Correlations among these variables are presented in Table 1.

Results of the ANCOVA tests are presented in Table 2. In support of H1, we found machine-written news induced less emotional involvement ($M = 3.88$, $SE = .12$) than human-written news ($M = 4.23$, $SE = .11$), $F(1, 344) = 4.40$, $p = 0.037$, partial $\eta^2 = .013$.

In support of H2B, regardless of the contextual differences in regard of media organizations and news type, we found that machine-written news was perceived as significantly more objective ($M = 4.54$, $SE = .12$) than the human-written news ($M = 4.11$, $SE = .12$). However, participants regarded the machine writer as having less expertise ($M = 4.61$, $SE = .09$) than the human writer ($M = 4.98$, $SE = .09$). No effect of news type was found on any of the dependent variables.

In support of H2A-a, as shown in Table 3, for NYT, a more trusted media organization in the current study, participants perceived machine-written news as more objective than that written by a human writer, but such difference between machine and human writer did not emerge for Fox, as shown in Figure 2. In support of H2A-c, and H2A-d, when machine writer was employed by Fox, machine writer was perceived

TABLE 2

Effect of machine authorship, news interpretation, and news organization with ANCOVA

	Emotional involvement	Objectivity	News credibility	Source trustworthiness	Source expertise
Writer identity (machine =1)	$F(1, 344) = 4.40,$ $p < 0.05,$ $\eta^2 = .013$	$F(1, 344) = 6.54,$ $p < 0.05,$ $\eta^2 = .02$			$F(1, 344) = 8.18,$ $p < 0.01,$ $\eta^2 = .02$
News interpretation					
Organization		$F(1, 344) = 6.43,$ $p < 0.05,$ $\eta^2 = .02$	$F(1, 344) = 11.82,$ $p < 0.001,$ $\eta^2 = .03$	$F(1, 344) = 5.99,$ $p < 0.05,$ $\eta^2 = .02$	$F(1, 344) = 10.81,$ $p < 0.001,$ $\eta^2 = .03$
Writer x Interpretation			$F(1, 344) = 4.44,$ $p < 0.05,$ $\eta^2 = .01$		
Writer x Organization		$F(1, 344) = 9.48,$ $p < 0.01,$ $\eta^2 = .03$		$F(1, 344) = 6.51,$ $p < 0.05,$ $\eta^2 = .02$	$F(1, 344) = 7.24,$ $p < 0.01,$ $\eta^2 = .02$

TABLE 3
Post-hoc analyses of the interaction effect of news organization and machine authorship

	<i>M (SE)</i>			
	<i>Fox News</i>		<i>The New York Times</i>	
	Human	Machine	Human	Machine
Objectivity	4.16 (.16)	4.07 (.16)	4.07 (.16) ^a	5.00 (.17) ^b
Writer's trustworthiness	4.81 (.14) ^a	4.22 (.14) ^b	4.80 (.14)	4.94 (.15)
Writer's expertise	4.94 (.13) ^a	4.22 (.13) ^b	5.02 (.13)	5.00 (.13)

Note: Pairwise comparisons were requested within Fox and NYT separately. Means with different superscripts differ at $p < 0.05$.

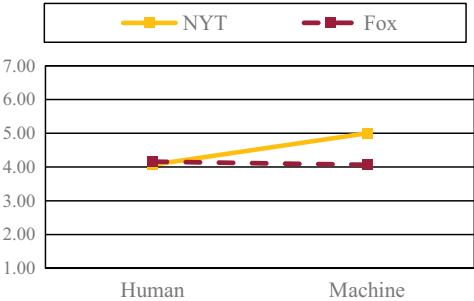


FIGURE 2
Conditional effect writer's identity on perceived objectivity for NYT and Fox

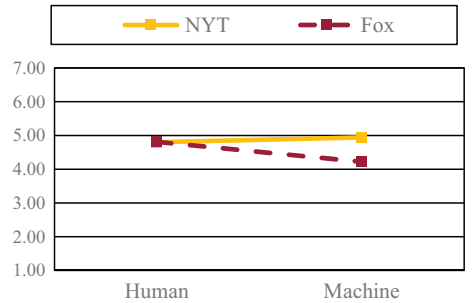
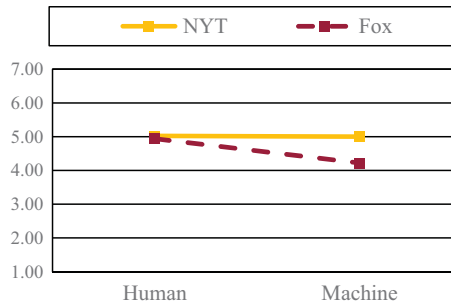


FIGURE 3
Conditional effect writer's identity on perceived writer's trustworthiness for NYT and Fox

as less trustworthy and of less expertise than the human writer, but such difference between machine and human writer did not emerge for NYT, as shown in [Figures 3](#) and [4](#), respectively.

In support of H3B-b, we found significant interaction effect of writer identity and news type on perceived news credibility. Specifically, for human-written news, there was no significant difference between news types that demand different levels of interpretation in terms of perceived news credibility. For machine-written news, however, spot news ($M = 4.56, SE = .17$) was perceived as significantly less credible than interpretive news ($M = 5.01, SE = .17$), $p = 0.052$. In addition, we found opposite patterns for different types of news such that interpretive news written by machine tends to be

**FIGURE 4**

Conditional effect writer's identity on perceived writer's expertise for NYT and Fox

perceived as more credible than that written by human writers, whereas for spot news, the one written by machine tended to be perceived as less credible.

Summary of Findings

In summary, we found machine-written news induced less emotional involvement and individuals perceived machine-written news as more objective, regardless of its institutional source or its type. However, machine writer was perceived as of less expertise compared with its human counterpart.

Further moderation analyses show that machine writer enhanced perceived news objectivity for NYT, but not for Fox. For Fox, machine writer was perceived as worse in terms of trustworthiness and expertise as compared to human writer.

Effect of machine authorship in enhancing perception of news credibility was more promising for interpretive news. For human-written news, there was no difference between spot news and interpretive news in terms of credibility whereas for machine-written news, interpretive news was perceived as more credible than spot news.

Discussion

Informed by research on mind perceptions of interactive intelligent agents (e.g., Gray, Gray, and Wegner 2007), machine heuristic (Kim and Sundar 2016; Sundar 2008), and information processing (Petty and Cacioppo 1986), this study examined the effect of utilizing machine in institutional news production on readers' processing and evaluation of the news. Consistent with past finding that suggest people attribute less mind and intentions to machine agents (e.g., Gray, Gray, and Wegner 2007; Kim and Sundar 2016; Liu and Wei 2018), we found news purported to be written by machine induced less emotional involvement among readers. In other words, when reading news written by machines, readers are less aroused by the news content. Although news industry does not and should not always pursue sensational effect among readers, contemporary digital journalism has already embraced more affective component in storytelling (Papacharissi and de Fatima Oliveira 2012; Wahl-Jorgensen 2016) and emotional involvement is also an indicator for how much the readers are engaged with the content and how much cognitive elaboration they generate while reading (e.g., Peters 2011).

Consistent with findings on effect of machine heuristic that machine is objective (Sundar 2008; Sundar and Nass 2001), we found news purported to be written by machine is perceived as more objective and balanced than that by human writer regardless of the news organizations and the news type, suggesting the robustness of such a belief about machine even in the news-writing context. However, the perception of objectivity might be nothing but unjustified over-trust in machine as absence of bias in news writing is too ideal to achieve in journalistic practice (Waddell 2018).

Most of the past studies on effect of machine authorship found news purported to be written by machine as no better than or inferior to human-written news (e.g., Graefe et al. 2016; Waddell 2018). Although we found machine is preferred on the dimension of objectivity, evaluation of news is more than judging how objective it is. As found in the current study, perceived objectivity of machine-written news did not carry over on other evaluative dimensions. Consistent with past research that finds computer as less favorable in terms of credibility, readability and journalistic expertise (Graefe et al. 2016), we also found machine writer was perceived of less expertise than human writer. The findings reflect the contemporary stereotype the public holds of machine as news generators, objective but not so advanced.

To explore the effect of employing machine writer in news production *in situ*, which is the main goal of the current study, this study contextualized news production by situating it in specific news organizations. On the selected news topics in this study, i.e., Obamacare, LGBT rights, and refugee admission, news and news writers of NYT were regarded as more trusted than Fox. Providing that the news content is the same, we found that for a more trusted organization (e.g., NYT), utilizing a machine as the news writer fosters perception of news objectivity among the readers. However, for a less trusted news media, applying machine in its news production worsens the situation such that the machine writer is perceived as less credible in terms of both trustworthiness and expertise than its human counterpart, despite that the news content is the same.

Such findings shed light on how individuals perceive the agency of machine and also the source orientation issue in human-computer interaction (HCI) regarding whether readers orient to someone behind the machine during interaction (e.g., Sundar and Nass 2001). With recent advancement in machine learning and the development of AI technology, the learning and decision-making processes of machine are largely autonomous to the extent that even human experts find it hard to explain why machine acts in certain ways (Hernández-Orallo 2017). However, despite machine's actual autonomy, when situated in institutions, it is still perceived as of less agency and machine-written news was perceived as in line with the valence of the institution's reputation such that machine only serves good for the good. That is to say, machine is not perceived as an autonomous, independent content producer, but merely an add-on and believed to be easier to manipulate than human professionals for a news organization (Carroll 2017). To be noted, this is not saying Fox is a less credible news media than NYT in general. The lower trust in news published by Fox in this study should be considered as determined by both the selected news topics and the sample characteristics.

The current study also found effect of machine authorship was contingent on the types of news. In this study, two types of selected news articles differ from each other in terms of length, amount of elaboration based on factual information, and degree of interpretation, which captured critical distinctions between spot news and interpretive

story. We found machine's potential in enhancing perception of credibility seems to be more prominent for interpretive news. Such a finding is consistent with the predictions of EVT (Burgoon 2016). Since human writer is expected to perform better in interpretive task such as news writing (Gambino and Sundar 2017; Haim and Graefe 2017; Nass et al. 1995), when machine successfully writes news that is more demanding in terms of information processing and writing, positive expectancy violation occurs and the pleasant surprise might further lead to more positive evaluations on news credibility. Such findings also disconfirm the alternative hypothesis that machine-written interpretive news will be less trusted because people won't trust machine conducting interpretive tasks (Nass et al. 1995). Findings in this study suggest "seeing is believing" such that participants accept that it is realistic for machine to do interpretive job, rather than only see what they already believe. Meanwhile it also suggests people's belief in machine's ability is malleable, which is line with findings that machine's ability to think and act does not violate individual's ontological assumption about machine (Gray and Wegner 2012).

Implications

Firstly, findings in the current study resonate with the research agenda proposed in Lewis and Westlund (2015) such that to better understand institutional news production in digital age, researchers should consider the interplay among the 4As, namely human actors, technological actants, audiences, and the activities of news production and interpretation. Although the current study did not look into the actual process of news production within a news institution, with an experimental approach, we found that impact of machine authorship on audiences is contingent on both the news institutions and the nature of the news content, suggesting that the interplay among the 4As could be complex and that more attention should be paid to the nuances in such interplay.

Secondly, this study has theoretical implication on HCI literature in general. As suggested by the paradigm of Computers Are Social Actors (CASA; Reeves and Nass 1996), technology users will apply social rules derived from human-human interaction to their interaction with technological artifacts mindlessly and treat them as if they are human actors. However, findings in this study suggest that human readers might not be so mindless as to react to an artificial agent in the same way as they do to a human writer. Instead, readers are less emotionally involved when interacting with contents generated by machine writer. In addition, findings such as machine-written news being perceived as more objective but machine as of less expertise, and machines run by less trusted news organizations being perceived as less credible altogether suggest we perceive machine to have less mental capacities than human beings.

Thirdly, this study has implications on information processing research in general. For online news consumers, not only does news content influence their judgments, but also other peripheral cues embedded in the interface impact their perceptions and attitudes by triggering relevant heuristics. Findings in the current study support this notion by finding simple manipulations of source cues (news organizations and news writer) swayed readers' judgements on the very same news content. More specifically, effect of source cues may function in two different ways. On one hand, they can trigger certain cognitive heuristics which drive further judgements making. On the other hand, they can

also set the expectations for the news content to be processed and the judgements are determined by whether the quality of the actual content lives up to the expectations set by the cues.

Besides theoretical contribution, this study also has practical implications on automated journalism. Many news organizations choose not to reveal the part played by machine in their news production as the public might be skeptical about this novel practice. However, as suggested by the current study, revealing the machine identity of a news article is not necessarily putting it in a bad light. Instead, we found machine authorship enhancing perception of objectivity when the news organization is trusted in the domain of the news reports. If the news content is more demanding in terms of interpretative skills, a job well done in writing such news will result in more fondness for the machine writer.

As machine is deemed of less mental capacity and therefore of less expertise in writing news, it will probably be helpful to reveal the “mental processes” of the news writing algorithm such as how it collects and analyzes data in order to help the readers form a more accurate and more concrete mental model of the machine writer, which will further help set appropriate expectations for the news content so as to avoid negative expectancy violations (Waddell 2018). In addition, thus far, most automated journalism practice is still conducted under human supervision or with human intervention. Acknowledging the role played by human journalistic professionals in this human-machine collaboration might help enhance readers’ mind attribution when reading the news so as to engage readers more emotionally and hopefully cognitively as well.

Currently, machine is mainly utilized in news domains that are data-driven such as weather, sports, and finance (Graefe 2016), which demand less interpretation and thoughtfulness compared with news on social and political issues. As we found in the current study, machine writing news that demands more cognitive work results in positive expectancy violation and fosters more positive evaluation. Therefore, news media might consider advancing their news-writing machines and expanding their realm to domains that require more interpretive work.

Limitations and Future Work

Despite the implications of our findings, this study also has several shortcomings to be addressed. First, in our operationalization, we used NYT and Fox as proxies for the credible and incredible news organizations. However, we did not measure participants’ trust in the two organizations directly and the decision to use them as proxies for less and more credible organizations is post-hoc in light of the data and also context-specific such that NYT is not necessarily more trusted than Fox. Instead, both are prestigious and influential mainstream news media in the United States. In addition, it is important to test effect of institution’s reputation in a nonpartisan context. Therefore, findings of this study should be interpreted and generalized with the selected news topics and target audiences taken into account.

Second, with a specific interest in and focus on how much cognitive capability it demands to compose the news, the news articles we presented to the participants were not perfectly matched with two different news genres in journalistic practice. For example, we did not vary the linguistic style of the news writing, a dimension on which

spot news (hard news) and interpretive news (feature story) typically differ. Therefore, the conclusions might not be generalizable when hard news and feature story are strictly defined as in conventional journalistic practice. Linguistic style of a news article might trigger other related heuristics that influence readers' information processing and judgement making, which is subject to future examination.

Conclusion

In conclusion, we found machine-written news induce less emotional involvement among readers and perceived as more objective than the very same news purported to be written by human. Meanwhile, machine is perceived as of less expertise than its human counterpart regardless of the news organizations and the interpretation levels of the news. Machine is most effective in enhancing perceived news credibility when applied by a trusted institution and when writing news that is more demanding in terms of information processing.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

NOTE

1. Test of violation of the assumption of homogeneity of regression slopes suggest covariates in the analyses (i.e., issue involvement and political value) had no moderation effect on effect of the three factors (i.e., news writer identity, institutional source, and news genre).

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