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Automated News Reading in the Neural Age: Audience Reception and Perceived Credibility of a News Broadcast Read By a Neural Voice

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ABSTRACT

Automated journalism is rapidly developing in the news industry. Among the most recent and promising technological potentials are *neural voices*, i.e., text-to-speech technology powered by neural networks. Based on a reception analysis with in-depth qualitative interviews ($N = 12$), this study explores how Danish radio listeners receive a full news broadcast read by a neural voice and perceive the credibility of the neural reader and the news content. Results show that the participants divide into two types: the perspicacious listeners who realize or suspect that the news reading is artificially synthesized and, to some degree, are annoyed by it, and the oblivious listeners who believe the news is read by a human and are predominantly positive towards it. Participants from both groups pay particular attention to voice emotionality when evaluating the appropriateness of the neural news reader. Also, they tend to attribute human characteristics to the neural news reader. The participants single out the news messages as well as the media organization behind the news broadcast, rather than the neural voice itself as critical components constituting credibility. Transparency is of great importance when applying a neural voice in a news broadcast, since it is a prerequisite for credibility.


KEYWORDS

Text-to-speech (TTS); neural voices; automated journalism; credibility; anthropomorphism; Eliza effect

Introduction

Automated text reading is currently applied on many news websites as a tool for users who need—or prefer—to listen to written news, rather than to read it. Now, news organizations have begun to explore further possibilities for applying text-to-speech (TTS) technology in journalism (e.g., BBC 2020; WashingtonPost 2020), some even experimenting with artificially intelligent news anchors (Handley 2018). With the latest implementation of neural networks—designed as algorithms imitating how the human brain works and recognizes patterns—TTS technology is making such rapid progress in terms of human-like natural pronunciation and intonation (Cohn et al. 2020) that the technology has the potential to supplement regular human news reading on radio, in podcasts as well as on TV as voice-overs. Importantly, neural TTS may provide an economically sustainable

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way to produce audio content to audiences in remote regions that would otherwise have limited or no access to local news in audio formats on the radio or the web (Scott, Ashby, and Hanna 2020). Also, given the growing audience demand for news podcasts (e.g., Newman and Gallo 2019) the technology offers great potential for news organizations in general. As argued by Cambre et al. (2020), TTS will prospectively and increasingly be used to provide audio content online, “as long as the experience can be a pleasant and enjoyable one.” (Ibid., 1). This prediction may prove to hold for journalism as well. Still, the disruptive concept of applications and not humans reading the news, may entail issues with perceived credibility should the audience experience the voice as unnatural or alienating. Therefore, the first purpose of this study is to examine how radio listeners in a given language cultural setting—in this case, Denmark—experience news reading by a neural news reader, i.e., a text-to-speech synthesizer powered by deep neural networks. Secondly, the study seeks to investigate the factors that influence the credibility of news reading done by a neural speaker as perceived by a radio audience.

Recent research in other fields has shown that neural TTS voices are rated as more human-like, natural, familiar and likeable than traditional speech synthesizers (Cohn et al. 2020). However, research into the potentials and pitfalls of automatic text-reading for journalism is scarce (see Scott, Ashby and Cibin 2020, for an exception). Following other journalistic research into news automation (e.g., Clerwall 2014; Thurman et al. 2019), we argue that the audience reaction to this innovation will determine its implementation in the newsroom. There is a need to further study the audience reception of neural TTS technology in a journalistic context, since “the quality of a particular TTS will most likely not be perceived in a stable fashion across various application contexts.” (Wagner et al. 2019, 1).

While the scenario of artificial neural voices reading the news may be deemed dystopian science fiction by some, the progressive use of algorithms in written news journalism has already proven that automated journalism is in demand in the media industry (Graefe 2016). In addition, research shows that computer-generated news is perceived by the readers as credible and in many regards similar to regular journalism (Graefe 2016; Wölker and Powell 2021). As in the case of machine-written news, the automation of news reading might be considered a low-cost opportunity for journalists to allocate time from routine tasks to in-depth reporting instead (cf. van Dalen 2012). However, from the perspective of the users, there might be an essential difference between algorithms writing the news and applications reading it.

Literature Review: Audience Reception of Automated News Reading

As described in the introduction, research on audience reception of TTS technology in a journalistic context is limited. Still, the broader literature on the topic provides cues on how the general audience might receive neural TTS technology applied in radio news. This literature suggests that the perception of TTS is strongly shaped by listeners’ consciously or unconsciously comparing the sound to a human voice.

One strand of the literature argues that the naturalness of an automated voice is received positively by the listeners. When people perceive an automated voice to sound similar to a human voice, it can lead to a halo-effect and the message will be more positively received than when the voice sounds unnatural (e.g., Torre and White

2021). Conversely, another strand of the literature suggests that a natural voice is not always better. This can be explained by the “uncanny valley”-effect which has been observed in human reactions to robots. The uncanny valley-effect (Mori 1970/2005) refers to “a perceptual tension arising from mismatched stimuli causing incongruence between users’ expectations of a system and its actual capabilities” (Clark, Ofemile, and Cowan 2021, 323). The more humanlike a robot is, the more positive attitudes towards it, but there is a point when the robots become so realistic that it becomes creepy. Similarly, verbal uncanny valley-effects have been observed (Clark, Ofemile, and Cowan 2021) showing that for certain types of speech, computer-like voices are preferred to more human-like voices.

In a journalistic context, Waddell (2018) showed that expectancy violations of automated journalism negatively affect news credibility. Waddell compared audience reactions to a news article which was allegedly either machine-written or written by a human journalist. The more natural and human-like the author behind the article was perceived, the stronger the expectation towards the article. When these expectations were not met, the expectation was violated which negatively affected the credibility of the article. By extension, if the sound of an automated newsreader is perceived as highly natural or human-like, this leads to strong expectations about the news that is delivered and the way it is delivered. People could for example, expect that appropriate emotions can be felt in the voice, and if not, the public might be disappointed. The results of an exploratory study testing the suitability of TTS for radio supports this view (Scott, Ashby, and Hanna 2020). This study suggests that pseudo-human sounding TTS radio, can lead to negative responses, as people might feel manipulated and tricked into believing that they are listening to a real voice. Based on this the researchers concluded that the development of speech technology for radio should primarily focus on “improved pronunciation, speed, and suitability of voice to content, while not assuming that increased ‘humanness’ is a necessary precursor to these factors.” (Scott, Ashby, and Hanna 2020, 8). In a related study, it was concluded that TTS was considered suitable for informational radio content, but less so for more creative and emotional genres, since the TTS voice gave a feeling of emptiness (Scott, Ashby and Cibirin 2020). These results suggest that naturalness is not always the gold standard. In their overview of the state-of-the-art of speech synthesis evaluation research, Wagner et al. (2019, 2) conclude that “*appropriateness* given a certain situation or application may be thus a better indicator of measuring the suitability of a certain speaking style over another.”

Based on perceived speech style, voice characteristics and language variant, people tend to socially categorize speakers in memberships with stereotypical traits that can be considered either positive or negative in a given cultural and social setting (Dragojevic 2018), and which can affect the perceived competence, expertise and likeability of a person (Garrett 2010). In relation to automated voices, recent research has shown that people tend to transfer such social assessment of human voices to artificial voices, for instances in the case of AI-systems such as Alexa (Cohn et al. 2020). Consequently, it may be expected that listeners will also tend to categorize neural news readers in memberships according to stereotypical perceptions and assess the perceived persona of the neural reader.

Hofstadter (1995) coined the so-called “Eliza effect” to describe people’s tendency to attribute human characteristics to computers. He observed that when interacting with

an automated system, people interpret the actions of the computer by making a parallel to human behavior. Thereby the users attribute the behavior of the computer to intrinsic feelings or motives that the system is not actually capable of. This attribution of human characteristics, emotions and motives to non-human entities is referred to as anthropomorphism and even takes place when people are fully aware that they are interacting with an automated system. Studying anthropomorphism in a journalistic context (Zarouali et al. 2021) observed that while people seemed to be cautious to describe chatbots as human-like, they did attribute human characteristics to the bots. Zarouali et al. (2021) showed that such anthropomorphism positively affected the credibility of chatbots and made people more susceptible to counter-attitudinal news when it was delivered by a chatbot. This suggests that anthropomorphism in text-to-speech journalism could be positively related to trust in the news reader and, by extension, in the news itself. However, associations with robots might also trigger further negative attitudes towards artificial voices replacing journalists due to a concern about robots replacing humans, referred to as the “Frankenstein complex” (Kim and Kim 2018).

Other Factors of Credibility

As outlined, the naturalness and situational appropriateness of an automated voice as well as the attribution of human characteristics to the voice may have both a positive and negative influence on the general reception and the perceived credibility of automated news reading. In addition, a long line of research in news journalism suggest that other factors may contribute to credibility of automated news reading as well. To situate formulation, oral presentation, content and other factors which together constitute the credibility of neural news reading it is useful to distinguish between message credibility, source credibility and media credibility (cf. Metzger et al. 2003; Koliska et al. 2021).

Message credibility has been defined as “an individual’s judgement of the veracity of the content of communication” (Appelman and Sundar 2016, 63) or “the perception of news messages as a plausible reflection of the events they depict.”. Appelman and Sundar (2016) distinguish three factors underlying individual judgements of message credibility: accuracy (whether the message is seen as factually correct and precise), *authenticity* (whether the message is seen as genuine), and *believability* (whether the message is seen as plausible and convincing). Metzger et al. (2003) point to the way messages are delivered as one of the dimensions which affect whether a message is perceived as credible. This supports our argument that naturalness and situational appropriateness matter for the credibility of automated news reading. Other dimensions which may affect message credibility are content, adherence of or deviations from genre conventions and prototypical news message structure, as well as opinionated language.

Source credibility, on the other hand, concerns the trustworthiness of several individuals or parties in news broadcasting, including the newsreader (or TTS-application), the authoring and editing journalists (or algorithms) as well as the quoted parties and the media company in charge of the production. As a complex unit they articulate, formulate, and/or is responsible for (parts of) the message, corresponding to what Goffman in his footing theory has termed the animator, the author and the principal (Goffman 1981). This layered conception of the source is central with regards to the neural news reader,

who only acts as the animator, i.e., the one who reads the news. The literature distinguishes between different factors which together make up the credibility of a source, such as likeability (e.g., Petty, Cacioppo, and Schumann 1983), expertise (e.g., Stoltenberg and McNeill 1984), and competence (e.g., Chebat, Filiatrault, and Perrien 1990).

Finally, media credibility, concerns the “relative believability of particular forms of communication (e.g., newspapers versus television).” (Metzger et al. 2003, p. 296). Metzger et al. (2003) point out that technological features such as whether the medium is text- or audio-based affect how audiences assess media credibility. The same goes for the political-economic features of the medium, such as whether the medium is privately owned or funded through public service.

Research Questions

In sum, the broader literature on audience reception of TTS technology points to perceived naturalness and situational appropriateness of the automated voice as well as the tendency for anthropomorphism as important factors for the reception of the news broadcast. This beckons our first set of research questions:

RQ1: How do the listeners perceive the voice and speech style of the neural news reader in terms of *naturalness*?

RQ2: How do the listeners assess *the situational appropriateness* of the neural news reader?

RQ3: Do the listeners *anthropomorphize* the neural news reader, and if so, how?

As outlined, these issues may increase or decrease the perceived credibility of the news reader as the animating source while other potential factors may influence the general credibility of the news broadcast as well. This leads us to our final research question:

RQ4: Which other factors contribute to the perceived credibility of news read by a neural reader according to the listeners?

Method

To address our research questions, we have applied a series of retrospective qualitative interviews in a reception analysis of a full news radio broadcast read by a neural news reader.

Sampling

A sample of 12 Danes was recruited to participate in the study based on a purposive participant selection strategy. This number of participants is aligned with the recommendation of 15 ± 10 made by Kvale and Brinkmann (2015, 167) To achieve maximum insight in the perception of a neural news reader the inclusion criteria was that participants listened to Danish commercial or public radio daily instead of specific sociodemographic characteristics. Regarding the role of the interviewees, our research question calls for representative interview participants (Harrits, Pedersen, and Halkier 2010, 200), i.e., that

the participants contribute with their perception of a phenomenon (the neural news reader). As recommended by Weiss (1995) we composed a varied selection of interviewees consisting of six female/six male participants to ensure both male and female perceptions of the female neural news reader. Besides six participants were above the age of 45 and six were under 45 (average age 47) to account for differences in perception related to age. Due to the limited sample size these differences in background variables are not used in the phase of analysis, but to compose a varied selection of representatives. The recruitment was professionally conducted by the recruiting company Wilke A/S which recruited the participants via an online panel. The interviews were conducted by one of the authors of this article (6) and a student assistant (6), and participants received a monetary incentive. The characteristics of the 12 participants are presented in Appendix 1.

Denmark is a small Nordic country with approximately six million inhabitants and the country is at the digital forefront. Due to a long-standing focus on digitization in both the public and private sectors, Denmark has a good starting point for using new technologies and a population adaptable and open to new technologies, e.g., 94% of Danish citizens are online making their digital skills highly advanced (The Digital Economy and Society Index (DESI) 2019). Due to these characteristics, Denmark is an interesting case to carry out research on new technological developments such as the reception of automated news reading, since we assume that broadcasters in less digitally advanced countries can benefit from the insights produced in this study.

Stimulus Material

Among the latest innovations in TTS, the neural voices developed by Microsoft as a part of their Azure Cognitive Services—a cluster of AI services and cognitive APIs (Soh et al. 2020)—has supplied a particular fitting choice for the purpose of our research project. While there are other similar services on the market, e.g., Amazon Polly and Google Cloud TTS, Azure has the advantage of supplying neural voices speaking in a wide variety of languages and settings, including a Danish female neural speaker named Christel, which we have chosen as a case due to our regional setting. The downside of choosing a commercial neural TTS is that Microsoft has not—to the best of our knowledge—openly shared how their neural voices are created in detail. Still, the general principles behind neural TTS technologies have been shared by the developers of the open source version of DeepVoice in a series of publications (Ping et al. 2018). Also, at the time our study was conducted there was no male equivalent to Christel's female voice in Danish, so the gender was a given. Although the speech style of the neural voice Christel is highly similar to standard Danish pronunciation and intonation, there are still subtle tell-tale signs that may disclose that the speech is not natural. The deviations are somewhat comparable to Danish speakers with an accent as well as speakers with monotonous intonation patterns, for instance caused by lack of interest, inexperience in reading aloud or by nervousness. The fundamental frequency of the neural voice averages 200 Hz in the news readings corresponding to a perceived pitch of a young to middle-aged female speaker (e.g., Skoog Waller and Eriksson 2016); and the reading averages 3,2 words per second which is equivalent to the tempo of modern-day news reading in Danish radio news broadcast (Thøgersen 2011). For further details about the stimulus material see Appendix 4.

Study Design

In journalism studies, most interview-based studies are retrospective asking participants to reflect on their overall experience with journalism (Kormelink 2020). This approach entails the risk that participants may tell more or less coherent stories, and that they may speak in generalities and misremember or forget details (Kormelink 2020). To overcome this methodological challenge, we apply a method referred to as “watching—or in our case *listening* to—and discussing news” (Kormelink 2020, 870). The main benefit of applying this method is that the participants reflect on a past experience (listening to news) to obtain a more reflective perspective on their experiences with audio news. Specifically, the participants were asked to listen to the stimulus material at home as preparation for the interview while they were taking notes on impressions. Hereafter, the participants were interviewed about their experience. Kormelink (2020) concludes that this retrospective approach grounded in an immediately preceding experience can advantageously be applied to apprehend how participants experience and make sense of news content and form.

The interview guide (see Appendix 2) was based on the research questions and a comprehensive review of the literature. We used a semi-structured interview guide to achieve an open and receptive flow in the interview, specifically we asked questions and used wording which seemed most appropriate in each interview (Kvale 1996, 129). In the semi-structured interview guide, the research questions were operationalized in three sections: the first focused on the participants’ reaction to the neural news reader without them being informed that the voice was automated and not human. By doing so, it was possible to examine their *unprimed* experience of the speak and the speaker. In the lead-up to the second section, the participants were explicitly told that the news reading was conducted by a neural news reader, thus *priming* the participants before questioning them further. In this section, the interview focused on participant perception of credibility. Finally, in the third section, the participants considered the attribution of human characteristics to the automated voice.

Data Collection and Data Analysis

The 30-minute semi-structured qualitative interviews were conducted online, audio-visually recorded and transcribed non-verbatim.¹ An informed consent was accepted via e-mail by all participants before the interview. Member checking was done while interviewing, as the interviewer made summaries of her/his understanding of the message conveyed by a participant. In this manner, the participant was given an opportunity to confirm or correct the interpretations made by the interviewer. All data collection procedures complied with data protection requirements (GDPR) and were approved by lawyers at University of Southern Denmark which process cases and approve reviews of research projects that process personal data.

The data analysis consisted of five phases (Boyatzis 1998). In the first phase of the data analysis, two researchers from the team familiarized themselves with the data set by listening to, reading and re-reading the interview transcripts. Hereafter, in the second phase, a coding list was constructed informed by 1: an initial open and inductive production of general level codes (e.g., perceived age of speaker) from the data, and 2: a theory driven,

deductive code production (e.g., uncanny valley-effect). In this process all codes were matched with data extracts to demonstrate it (for coding list see Appendix 3). The third phase consisted of a focused coding of all data from the 12 interviews, this was done in a spread sheet to secure reliability. All data extracts were coded, and individual extracts of data could appear in as many different codes as they fit into, so an interview extract was often coded several times in this phase. In the final phase, a thematic analysis was conducted. At this point, the researchers re-focused the analysis on a broader level of themes, rather than codes (e.g., transparency as a prerequisite for credibility). The process consisted of sorting the different codes into themes and ordering all the relevant coded data extracts within the identified themes. In the same process, counter systematics that could go against the emerging patterns of similarities and differences were identified to ensure homogeneity, and, thus, internal validity.

Results

Naturalness

Based on their responses to the initial questions in the interview, the participants divide into two groups:

- The perspicacious participants: those who realized or suspected that the news reading was synthesized before being told
- The oblivious participants: those who did not notice that the news reading was synthesized until being told

These groups reflect that the synthesized reading sounds natural and similar to regular news readings to some participants, but not adequately natural to go unnoticed by participants who are potentially (highly) attentive or/and sensitive to deviations from natural standard enunciation and intonation. As phrased by one of the perspicacious participants:

It deviated from what I am used to hearing, so I halted a bit and started to focus on it instead. It was definitely something that removed my focus from the news a bit because it deviated from the norm. (#4, M, 25, unprimed phase, perspicacious participant)

In the interviews, the perspicacious participants initially try to verbalize that they do not consider the voice human. They describe the speaker and the voice as “unnatural”, “unpersonal”, “a robot”/“robotic”, “a machine”/“mechanical”, “a computer-voice”, “like a GPS”, “like Google Translate”. Specifically, the perspicacious participants point towards a series of deviations from natural voices and standard speech styles that indicate that something is off with the voice and the reading. They describe it as a harsh (not humanly “soft”) voice with unnatural pauses, lack of breathing as well as a monotonous intonation, modulation and tone of voice. In addition, they remark that the pronunciation of certain inflections, consonants, and specific words is peculiar and divergent from standard pronunciation and that there is a lack of normal human reaction such as a pause, an “er” or a correction after having pronounced such words in an imprecise or divergent manner. Overall, the perspicacious participants give an elaborate layman account of the phonetic deviations from standard Danish as well as some of the physiological deviations from natural reading patterns (Watt and Burns 2012). They are, in other words,

aware that the voice and the reading might not be naturally human, and they can articulate conspicuous differences.

The attitudes of the perspicacious participants to the voice and the news reading are divided into a neutral and a negative stance in the unprimed phase. The neutral standpoint emphasizes that although the voice and the reading is mechanical, it is not annoying as such or too conspicuous, e.g.:

It did not bother me as such [...] I could feel its vibe in terms of it being traditional radio news, but there was a different feel to it because I thought it was the voice of a robot. (#4, M, 25, unprimed phase, perspicacious participant)

Conversely, the negative stance emphasizes that the mechanical voice is annoying, e.g.:

Actually, I got so annoyed at her, this computer voice, that it prevented me from focusing on what was really said. (#2, F, 39, primed phase, perspicacious participant)

As illustrated in this example, the unnaturalness of the neural voice may trigger annoyance that leads to loss of concentration forcing the listener to either revisit the passage again or simply miss out on the information. Such annoyance may also affect the likeability of the voice—and according to theory, the source credibility—which is illustrated in the given case where the listener is quite vocal and emotive regarding her annoyance: “God, she sounds annoying.” (#2, F, 39, primed phase, perspicacious participant).

Still, the less critical of the perspicacious participants explicitly identify the naturalness of the automated voice as a potential positive influence on credibility, although the effect is debated:

It sounded almost human which leads to some credibility, although you probably also realize that it is not a real person. (#10, M, 27, primed phase, perspicacious participant)

In comparison, the oblivious participants are predominantly positive when describing and assessing the news reader and do not express annoyance. Instead, the halo-effect seems present at times potentially influencing the overall experience of the news broadcast:

I think she [the news reader] was skilled. You did not lose interest or anything. [...] She was easy to understand. I thought there were some really cool topics actually [in the news broadcast]. They were different, but good. (#5, F, 55, unprimed phase, oblivious participant)

Appropriateness

According to theory, a neural news reader which is perceived as natural and human-like leads to strong listener expectations about the news that is delivered, and the way it is delivered. Accordingly, our data show expectancy violations regarding the emotionality of the automated voice. The most distinct example is the way participants express disappointment when the automated newsreader does not express appropriate feelings. The following quote is an example of how participants express their expectations of appropriate voice emotionality:

Whether you talk about rain or sunshine, you can sometimes hear them [the newsreaders, ed.] smiling. Yes, it will be 30 degrees tomorrow, then you can hear them smiling through

their voice. Or they say, oh, its gonna rain next week, then you can hear that they are like, aw, it's kinda like, bummer, in their voice. (#5, F, 55, primed phase, oblivious participant)

As this participant clearly describes, voice emotionality is an expected prerequisite in weather reports, but participants also express expectations of voice emotionality on a more general level and when serious incidents occur:

A computer voice does not react to bad news. It does not care. It does not react to great news either. But a human news reader that tells you that Denmark has won the European Championships or that a famous person has died, will always assume some kind of exultation or sadness in the voice. [...] There has to be some emotion, there has to be something in the intonation. (#2, F, 39, primed phase, perspicacious participant)

These participants find that the missing voice emotionality is a serious shortcoming in situations where appropriate feelings should be reflected in the voice of the speaker. On the other hand, other participants consider missing voice emotionality a strength:

You might say that a robot can make it more neutral. You cannot be manipulated into believing something based on the emotions of the speaker. (#3, F, 36, primed phase, oblivious participant)

According to these participants it is an advantage that an automated voice cannot consciously or subconsciously influence the radio news listener by expressing feelings, and this can positively influence the perceived credibility of the news reading.

Anthropomorphism

In our data set, anthropomorphism plays a prominent role in the participants descriptions. Significantly, participants from both groups supply detailed descriptions of the envisaged speaker persona:

I imagined a small, short-haired, blond lady around 40–45 years. That was the picture that came into my mind. I do not know why she would be blond and short-haired [...]. A small, cautious girl, perhaps. (#5, F, 55, primed phase, oblivious participant)

35–45 years, that's my estimate. [...] I imagine she comes from the capital region, and that she is long, dark haired and sits with a straight back [...] like Karin Cruz [...]. (F, 43, primed phase, oblivious participant)

As seen in both examples, the participants do more than just imagine the age of the persona, how she looks and where she comes from; they also describe how she is (“cautious”) and behaves (“sits with a straight back”) with implied connotations, i.e., that she is formal and authoritative. Thus, the anthropomorphic persona is constructed from both imagined personal attributes and personality traits as well as imagined behavioral patterns which is characteristic for stereotypical constructs (Leyens, Yzerbyt, and Schadron 1994). As evident from the last excerpt above, these conceptions may be based on prior knowledge of and exposure to media personalities, i.e., female news journalists and anchors that are familiar to the participants and may function as a sort of cognitive prototype for female news readers in general by association. This can be considered part of a stereotypical construct in which “previous experience moulds current perceptions” (Glăveanu 2007, 1). This also applies to prior negative experiences among the participants leading to biased perceptions of the constructed speaker persona:

A 29-year-old woman with shoulder-long blond hair who sits in a white tunic with a baby-blue flower pattern [...] I always feel like they resemble the same slightly annoying Copenhagen types who tries to, well, they want something more than what they are doing right now, so they have ended up somewhere on their career ladder in order to climb the hierarchy. Yes, I see a tiny bit of self-tanner and the blond hair and those loose, long tunic dresses. (#10, M, 27, primed phase, perspicacious participant)

The description shows how the voice has triggered a series of negative preconceptions of the membership category *aspiring career women from the capital*, including their perceived stereotypic looks, intentions and position in the social and professional hierarchy. The example documents how the anthropomorphic construction of the persona can be quite complex even among the perspicacious participants.

The intricacy of the constructed persona is also manifested in the following example in which an oblivious participant gives a narrative account of the imagined personal background of the speaker persona:

A girl, lady, 25–30 years old. She has just finished her education as a journalist. I imagine that she has got this cool job at Radioavisen, I imagine it must be. The person who has hired her, has not really listened to her radio voice or had her tested in a radio studio. She does everything perfect, or almost perfect, although there is this pronunciation issue, but there are no faults as such in her reading. I really sat there imagining this and pitied her for not reading properly. (#11, F, 39, primed phase, oblivious participant)

Not only does the oblivious participant give an account of the speaker persona's professional life story, the participant also expresses sympathy with the imagined young and recently educated woman who tries to be perfect but according to the narrative fails. Thus, while explicit antipathy is articulated among the perspicacious participants at times, the oblivious participants tend to express less salient negative attitudes downplayed by pity.

Overall, the descriptions made by the participants document how prior experience and knowledge of female journalists and news anchors as well as stereotypical and biased preconceptions of aspiring women are used to construct an anthropomorphic speaker persona. This is done by:

- (1) attributing physical characteristics, personality traits and private intentions,
- (2) associating to similar and familiar media personalities,
- (3) categorizing the speaker as a member of a group defined by stereotypical attributes,
- (4) fabricating personal background narratives.

As a consequence, the perceived likeability, expertise and competence of the neural news reader is at times dependent upon the stereotypic membership category the anthropomorphic persona is assigned to by the participants.

In general, however, the participants tend to identify other factors that according to them are more prominent in constituting credibility than the perceived speaker persona.

Other Factors Constituting Credibility

Participants across the two groups find that the neural news reader has relatively little impact on credibility, because as they see it, credibility is mainly rooted in the content and/or the media organization producing the news broadcast, i.e., message and source

credibility. As the quote below illustrates, these participants are more concerned about deciphering if they can trust the content of the news than in deciphering if they can trust the voice:

IR: Were there any of the news stories where the reading determined the credibility?

IE: No, it was all about the content.

IR: So, you trusted the reading?

IE: Yes, I did not speculate that it was not trust-worthy. It was okay. It was the content that mattered. “(#12, F, 59, primed phase, oblivious participant)”

In theoretical terms, the news content lives up to the participant’s news genre expectations which implies that the content is considered adequately accurate, authentic, and believable—and, by extension, credible. Also, the participants comment that the structure of the news broadcast meet the normal genre conventions:

The structure of the program was organized exactly as usual. (#6, M, 46, unprimed phase, oblivious participant)

The fulfilled genre expectancy is also supported by participants highlighting the use of reportage and exemplars—i.e., an “illustrative individual case” (Brosius and Bathelt 1994, 48)—in the news broadcast which to them contributes to the authenticity and believability of the news:

So, to me, it also increases credibility [in the news feature] to get out into the real world. The fact that she [= the exemplar, a beautician who treats skin issues caused by face masks] had several inquiries, and she was busy in her store, and several sought advice from her, it also seems credible to me [...] (#7, F, 43, Marlene)

Apart from perceived credibility being rooted in the structure and content of the news message, participants argue that credibility is also rooted in the media organization behind the news broadcast, i.e., the principal source. In the interview data both groups of participants (oblivious and perspicacious) explicitly ask themselves who is behind this news broadcast read by the automated voice. All participants conclude that DR is the organization behind the news broadcast, and they reason that if they trust DR in general, they also trust the content and the neural news reading:

Well, it is my experience that the news from DR is actually quite credible. (#1, M, 66, primed phase, oblivious participant)

This attitude corresponds to the general public perception in Denmark of DR as the most credible source among Danish media (Andersen et al. 2021, 135). As argued in the theory section, this type of source credibility implies that the participants associate the media organization with journalists that are likeable, competent and experts. However, it may also be more generally prompted by media credibility in the sense that DR is formally obligated by contract to conform to traditional public service rules and conventions in Denmark.

Relatedly, participants also highlight the news program, Radioavisen, as a credible source in itself. and even consider the intro jingle from the program a cue that primes their perception of credibility:

It is probably because of the quality mark it [the news broadcast] has gotten from the intro [jingle] from Radioavisen. You know it’s valid. (#11, F, 39, primed phase, oblivious participant)

In sum, according to these participants, the main components in establishing credibility in an automated news reading, are the credibility of the news message, the principal source credibility of the news organization and news program, and, potentially, the media credibility linked to public service standards.

According to both the oblivious and the perspicacious participants, the prerequisite for establishing and maintaining the necessitated credibility in and around an automated news reading is transparency:

First and foremost, I would say that you have to inform about it [that the voice is not human, ed.]. Because if you do not and people catch on to it—they will feel somewhat tricked. (#10, M, 27, primed phase, perspicacious participant)

When talking about transparency, the participants mean that they want to be informed whether it is an automated voice or a human being reading the news. If they are not informed, they state that they might feel deceived and are left with feelings of insecurity and lack of control:

It would be appropriate to be informed that it was a robot. [...] You feel sort of cheated or you lose control. You lose control with what you thought it actually was. (#3, F, 36, primed phase, oblivious participant)

As this participant vividly describes, one can experience feelings of deception and a loss of control if it is unclear whether an automated voice or a human reads the news. Such reactions are related to the uncanny valley-effect and the Frankenstein complex (cf. theory section) which is also observed in other parts of our data set. In both the groups, oblivious and perspicacious, participants express that reflecting upon automated voices reading the news makes them foresee frightening scenarios which makes them feel insecure, especially if the news reading is not transparently labeled as an automated news reading:

Is this where we are at now? I cannot even get a human to read my news? [...] It makes it a bit more creepy. (#10, M, 27, primed phase, perspicacious participant)

Also, the participants express concerns that automated voices may be used to manipulate the audience and spread lies and fake news:

You can use it to manipulate. You can use such a thing to tell all kinds of lies. (#9, M, 75, primed phase, perspicacious participant)

In our data, participants do not suggest that the automated news reading should be more computer-like to reduce the uncertainty and creepiness. Instead, they call for full transparency.

Despite this overall result that perceived credibility, for some respondents, seems not to be affected by an automated news reading, other participants from the group of oblivious participants experience that credibility is challenged when the automated voice reads the news. These participants seem to nuance their perception of what is at stake, since they argue that a human voice can contribute positively in establishing a credible relation between the listener and the news media outlet. One of these participants explain that in regular broadcast radio news, the host often ends the news reading by stating her/his name. According to these participants this efficiently adds to the perceived credibility, since the host becomes personally accountable for the news reading and its

Table 1. Factors potentially affecting the perceived credibility of neural news reading.

	Increasing credibility	Decreasing credibility
Message	<p>Accurate, authentic and believable content</p> <p>Familiar program structure and news formats that meet the genre expectancy of the listeners</p> <p>Natural-sounding news reading leading to potential halo-effects</p> <p>General lack of emotionality in the news reading leading to increased perceived objectivity and neutrality</p>	<p>Inaccurate, non-authentic or unbelievable content</p> <p>Unfamiliar program structure and news formats that do not meet the genre expectancy of the listeners</p> <p>Artificial-sounding news reading leading to annoyance or loss of concentration</p> <p>Lack of situationally appropriate emotionality in the news reading leading to expectancy violations</p>
Source	<p>The construction of a perceived speaker persona (anthropomorphism) categorized as a likable and competent person</p> <p>Well-known and trustworthy news program or media organization as the principal source</p>	<p>The construction of a perceived speaker persona categorized as a disliked and incompetent person</p> <p>Unknown and/or not trustworthy news program or media organization as the principal source</p>
Media	Adhering to public service news standards and conventions.	–
Context	<p>Transparency about the fact that the news reading is automated</p> <p>–</p>	<p>Lack of accountability concerning the automated news reader as the communicating source</p> <p>Concerns about applications replacing human news readers (the Frankenstein complex) and the fear of automated voices used to manipulate and spread lies and fake news</p>

content, i.e., source credibility in its broadest sense. This personal accountability of the human news reader will according to these participants prevent the news reader from conveying propaganda or misinformation. Conversely, an automated voice will, in theory, be able to read anything and never be held personally responsible.

In conclusion, we have found that the main component in establishing if an automated news reading is credible is whether the message and the source behind the news broadcast are perceived as credible. Furthermore, it is of utmost importance to the participants that transparency is prioritized, since it is a prerequisite for perceived credibility: the participants simply require knowing if it is a human or an automated voice reading their radio news.

The findings regarding credibility are summarized and illustrated in [Table 1](#).

Conclusion and Discussion

In this study, we have explored how radio listeners receive a full radio news broadcast read by a neural news reader and how they perceive the credibility of the broadcast. We have found that there are several factors that constitute the credibility along the three theoretical dimensions: *content*, *source(s)* and *media*. Importantly, the source credibility of the neural news reader was not the most significant factor for the participants who pointed towards credible content, familiar news structure and a well-known and trustworthy news program and media institution as the principal source, as more decisive instead. Also, in the endeavor of establishing and maintaining credibility, it is of great importance to the participants that transparency is prioritized, since it is a prerequisite for credibility when applying TTS technology. Consequently, the participants want to be informed in advance if it is an application that does the reading and who oversees it. It must be stressed, though, that the focus on transparency among the

participants may be caused by the study design in which the participants were not informed that the voice was automated before listening to it. They may have felt tricked and reacted accordingly when answering which corresponds to previous observations made by Scott, Ashby, and Hanna (2020). Furthermore, the fact that the stimulus material has been produced as a regular and well-known radio news program unquestionably affects the way the participants perceive credibility. Nonetheless, this choice of stimulus material has also been an advantage, since it relates to concerns associated with the ecological validity of evaluation practices. In most cases, evaluations of synthesized voices lack context, as they are tested in unrealistically ideal circumstances with high quality listening equipment and no noise, and involve generic tasks that do not reflect the real-world use cases (Cambre et al. 2020). The stimulus material in this project is quite the opposite, as it resembles real radio news and participants listened to it at home.

Although the participants identify the content, the media institution and transparency as the most important factors concerning perceived credibility, different aspects of the automated voice acting as the communicating source are also highlighted by the participants as influencing factors. Our results show that the participants pay particular attention to the emotionality of the voice when evaluating the appropriateness of the neural news reader. Some participants find the lack of voice emotionality advantageous, since an automated voice cannot (sub)consciously influence the radio news listener by expressing feelings. In contrast, though, other participants find the lack of sentiment in the voice to be a disadvantage, since the neural TTS voice cannot convey appropriate emotions which may lead to expectancy violations. Considering the last point, neural voices cannot—yet—differentiate between different rhetorical situations and adequate emotionality markers, but it may prove to be a facet that can be developed over time. In fact, experiments with robots mimicking the voice patterns of charismatic human speakers have shown promising results (Fischer et al. 2019). Neural technology has proven it holds the key to pattern recognition and impersonation of natural speech, and it could also, potentially, be able to figure out the acoustic properties and patterns associated with the emotionality of the voice (cf. Johnstone and Scherer 2000) in different situations and contexts. However, the uncanny valley-effect could be a latent side effect of this suggested future *emotional* neural news voice as already stressed by Scott, Ashby and Cibin (2020).

In addition, we found that the participants attributed human characteristics to the neural news reader thereby constructing an anthropomorphic speaker persona based on membership categorization and stereotypes. This was done in an intricate fashion including detailed descriptions of imagined physical characteristics, personality traits, private intentions and background narratives. The result resonates with the preceding research literature on language attitudes and anthropomorphism of text-to-speech-technology and highlights that neural news readers may be subject to socio-cultural preconceptions as if the readers were actual humans. In line with previous studies, our results indicate that such anthropomorphism may influence the credibility of the neural voice positively, but this causation is not clear-cut in our data. Rather, we observe that the differences in constructed speaker personae can vary quite radically and sometimes very concretely resulting in negative likability.

The limitations of the approach of this study include working with a small sample group of participants with a high interest in news. Besides, the news content was

embedded in a well-known news program from a highly trusted news organization in Denmark, hence alleviating potential concerns about message and source credibility. Consequently, in future research, we propose to replicate this approach by: (1) conducting experimental studies to fully investigate the correlation and potential causation between different types of constructed speaker personae and perceived credibility. Likewise, experimental studies could shed light on the potential differences of perceived credibility ascribed to male and female, young(er) and old(er) neural voices as well as variants in dialects and accents, something our chosen neural voice application did not allow. (2) adding studies where the news brand is not suggested, and where a low credibility brand is also suggested. (3) including participants who are less trusting of news and have lower news consumption/education, to see what impacts a neural newsreader would have on their credibility perceptions.

In a reflection on recommendations for the news industry, we limit ourselves to consider trustworthy news organizations. Based on the analysis and the discussion above, we first advise the news industry to communicate extensively and transparently to news users on why and how an automated news reader is used. Second, to consider which news genres and situations are best suited for automated news reading. Third, to give the choice of a neural voice as much consideration as a human news reader. A neural news reader should not be considered a mere technological application and impersonal voice, but rather a potentially perceived persona that the audience may have sympathy for or be annoyed by. A neural voice will, as any other host, have a contagious effect on a news brand and the organization behind it.

Note

1. Meaning that the transcription, was cleaned up to remove filler words, stammers and anything that took away from the core message of what was being said.

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