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Chapter 11
Public Perception of Artificial Intelligence: A Systematic Evaluation of Newspaper Articles Using Sentiment Analysis

Abstract: In our research, we focus on the reporting on artificial intelligence (AI) and related terms in newspaper articles and determine if the sentiment tone of the articles is positive, negative or neutral. We hypothesise that the tone of reporting about AI can shape consumer opinions and usage patterns since it increases familiarity and can therefore indirectly impact the level of trust towards AI among German consumers. We use a quantitative approach consisting of sentiment analysis of the leading newspapers (in terms of number of subscribers) in Germany to test our hypothesis and conclude that the newspapers have mostly published positive or neutral articles albeit the frequency of articles published on the theme of AI has decreased over the past 2 years. However, only a small percentage of articles discuss issues related to consumers and consumer protection, which might be directly relevant to the readers of the newspapers.

Keywords: artificial intelligence, algorithms, sentiment analysis, newspapers, public opinion

11.1 Introduction

Artificial intelligence (AI) and algorithms have long been a topic of interest for the public and have been portrayed in movies (e.g., *Terminator* and *Star Wars*) and media quite often as well. Over time, the use of AI in our everyday lives has become

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more and more prominent. From health care to human resource systems to financial advisory and driverless cars, algorithms are slowly sneaking into our lives. Despite the convenience and (in some cases) accuracy that AI brings with it, there is still a lot of variation in the degree of individual adherence to algorithmic advice; scepticism and algorithmic aversion can be observed among groups of the public about it (Dietvorst, Simmons & Massey, 2015). There are several reasons behind this scepticism, including issues like data privacy (Fast & Jago, 2020), efficacy (Fenneman et al., 2021), ethical considerations (Lee, 2018), fairness (Castelo, Bos & Lehmann, 2019) and transparency (Dzindolet et al., 2001) of algorithms.

Newspaper articles and media can play an important role in shaping public opinion particularly about new technologies. The role of media in creating awareness and engagement towards scientific advancement has long been a topic of discussion in the literature (Nelkin, 1987; 1998) with the scientific community mostly holding a negative stance towards the criticism posed by media (Garvey, 2018). Similarly, within the AI community, there is a strong belief that the negative media coverage of AI and the use of imagery from the movie *Terminator* has played a significant role in increasing the scepticism and public concern towards algorithms and AI (Garvey & Maskal, 2019). This has in turn hindered public engagement on AI by creating a psychocultural barrier (Dotson, 2015; Garvey, 2018).

This negative view of the role of media has been somewhat explored in the literature by reviewing articles from international newspapers, including mainly *The New York Times* (Fast & Horvitz, 2016; Garvey & Maskal, 2019) and from social media site and blogs (mainly Twitter). The results in the literature are mixed with most studies not finding clear evidence of the link between negative hype of AI and the low public engagement of it (see Section 12.2).

We have only been able to find one (non-peer-reviewed) study and one blog article on the sentiment in German newspapers on the topic of AI.[1] This is especially interesting because the German public relies heavily on newspapers to get information on current events. More than 11.72 million copies of traditional newspapers circulate every day in Germany (Bundesverband Digitalpublisher und Zeitungsverleger, 2022). Newspapers in Germany potentially play an important role in forming public opinion about important topics, including AI and algorithmic usage in everyday life. Through this chapter, we intend to add to this limited literature and explore the role of German newspapers in depicting positive or negative sentiments towards AI.

Our study is guided by four main research questions:

- What is the frequency of articles published on the theme of AI and algorithms?
- What has the sentiment tone of newspapers been about the theme of AI and algorithms?

1 Ozgun and Broekel (2021) have discussed innovation and technological news in German media but have not specifically focused on artificial intelligence.

- To what extent do AI and algorithm-related articles discuss consumers or consumer-related issues? Does the sentiment score differ for this subsample?
- Are the sentiments expressed by newspaper articles reflected in the public opinion of AI and algorithms?

To answer our research questions and have a more in-depth analysis, we limited our sample size to three German newspapers, each with a different orientation (tabloid, national and regional quality newspaper) targeting a different stratum of German population. After retrieving the articles from the sample newspapers, we opted for a sentiment analysis approach to determine if the articles portrayed the use of AI and algorithms in a positive, negative or neutral light. In addition to this, we also conducted robustness checks on our findings by comparing our results with regional and national German public opinion polls on AI and algorithms. We discuss our methodological approach in more detail in Section 12.3.

Through this research, we hope to add to the current literature on two levels: first, we want to explore the current sentiment in the German media about AI and algorithms, which has been almost missing from literature so far. Given that the EU hopes to be at the forefront of technological progress, our research can play a pivotal role in understanding the current sentiment of discussions in the media about technological changes related to algorithms and AI. Secondly, we hope to add to the bigger debate on the role of media in increasing or decreasing public engagement towards AI and algorithms.

We have divided the chapter into five sections: in Section 12.2, we explore the literature related to AI, algorithmic aversion and the role of media. This is followed by Section 12.3, which explains the methodology and results of the chapter. In Section 12.4, we analyse the results and compare them with other studies and public polls held in Germany and discuss broader conclusions from our results.

11.2 Sentiment Analysis and AI: A Literature Review

Over the last years, several problems and scandals with regard to AI have been published in the German press. Examples for negative press reports about AI are the open letter of warning about AI risks which was signed by more than 100 AI experts, such as Stephen Hawking and Elon Musk, and was addressed to the United Nations (Armbruster, 2017), the Facebook–Cambridge Analytica data scandal (Zeit Online, 2018), discrimination against women in Amazon's AI application system (Sackmann, 2018) and crashes of autonomous cars (Handelsblatt, 2021).

However, studies on the sentiment of news articles about AI in the USA report a positive sentiment towards AI (Fast & Horvitz, 2016; Garvey & Maskal, 2019). Nevertheless, while the results of a content analysis of five major American newspapers also

support these findings by reporting that the share of articles discussing the benefits of AI is higher than the share of articles discussing the risks, they also report that the discussions of the disadvantages and risks are more specific (Chuan, Tsai & Cho, 2019). Moreover, while the general sentiment in AI may be positive, dividing the news articles on AI into sub-topics leads to a more precise analysis of the sentiment and reveals differences between the sentiments of the articles of the various subtopics. For example, while the general sentiment of AI articles was reported to be positive by several studies (Fast & Horvitz, 2017; Garvey & Maskal, 2019), articles on the ethics of AI were found to have a neutral sentiment (Ouchchy, Coin & Dubljevic, 2020).

In the recent years, the frequency of press articles on AI has decreased. Garvey and Maskal (2019) report a decrease of news articles on AI since 2016. This is somewhat surprising as the number of scientific publications in English on AI increased from 194,194 publications in 2016 to 334,497 publications in 2021 (Zhang et al., 2022). This indicates different trends for scientific publications and non-scientific publications, which might reflect a declining interest of the public in the topic. Garvey and Maskal (2019) offer another possible explanation for this difference by stating that public engagement is restricted by measures as banning journalists from workshops and tutorials on AI conferences (Shead, 2018).

For the German media market, similar peer-reviewed studies do not exist to the best of our knowledge. We are only aware about one study of the Bertelsmann Stiftung (Fischer & Puschmann, 2021), one blog article including a sentiment analysis for German newspapers on AI (Illner, 2022) and the AI Monitor 2022, where the tonality of articles is part of the AI index (Bundesverband Digitale Wirtschaft e.V., 2022). In his blog article, Illner comes to a similar result as Garvey and Maskal (2019) by analysing the press articles of 3000 publications and reports a decrease in press articles on AI from January 2020 to January 2022. Fischer and Puschmann (2021) come to a different result and report that the number of articles in the leading German newspapers continued to increase until 2020. A decreasing frequency of newspaper articles on AI may seem surprising, considering the fact that AI is being used more and more. From 2018 to 2022, the percentage of companies that use AI increased from 11% to 37% (Bitkom Research, 2022).

According to the non-peer-reviewed blog article from Illner (2022), the share of negative press articles is lower than the share of positive press articles on AI and even decreased from 20.5% in 2020 to 17% in 2021. Simultaneously, the share of positive press articles increased from 32.3% in 2020 to 35% in 2021 (Illner, 2022). Furthermore, Fischer and Puschmann (2021) report that more articles and posts from leading German newspapers, subject blogs and Twitter messages are positive than neutral or negative towards AI. However, the Bundesverband Digitale Wirtschaft e.V. (2022) reports that the proportion of negative and positive articles from German newspapers between 2019 and 2022 was balanced but that there is a small increase in positive articles.

The German population's attitude towards AI has changed over time; more precisely, it has become more positive since 2019 according to a survey among the German population (TÜV-Verband, 2021). While in 2019, 28% of the respondents had a negative attitude towards AI, only 14% of the respondents in 2021 had a negative attitude towards AI (TÜV-Verband, 2021). The share of people with a positive attitude towards AI increased from 46% in 2019 to 51% in 2021 (TÜV-Verband, 2021).

Several studies have reported that the sentiment of media influences the public opinion about AI (Fast & Horvitz, 2016; Nader et al., 2022; Ouchchy, Coin & Dubljevic, 2020). The sentiment of the media is particularly important for shaping public opinion on new, unfamiliar technologies, such as AI, where many people feel unsure about the risks and benefits (Chuan, Tsai & Cho, 2019). It can thus be assumed that more positive press reports about AI would promote a more positive public opinion about AI. Furthermore, in a survey conducted by TÜV-Verband in 2019 in Germany, 59% of the respondents stated that positive reporting on AI in the media would increase their trust in products and applications using AI (TÜV-Verband, 2021).

The sentiment analysis is considered as one of the most accurate methods to evaluate text in terms of its sentiment and emotions (Hossain et al., 2021). However, using this method to analyse texts on AI has some limitations. The term artificial intelligence has no universal, specific definition and people have different understandings of what AI is. As a result, some people associate certain terms with AI and others do not associate those terms with AI. Therefore, AI is a difficult topic to conduct a sentiment analysis on and the search words must be considered carefully (Fast & Horvitz, 2016). Additionally, the result of the sentiment analysis can be distorted by rhetorical stylistic techniques such as irony, ambiguous words, abbreviations or typing errors (Hossain et al., 2021). For this reason, some studies decided to have people additionally evaluate the sentiment of the articles (Fast & Horvitz, 2016).

11.3 Methodology and Results

As mentioned in Section 12.1, we opted for a sentiment analysis approach as our main methodology. However, before we discuss the sentiment analysis, we explain our sample and data collection techniques in the following sub-sections.

11.3.1 Data Sampling and Collection

To have a more comprehensive overview of the news in Germany, we opted for three newspapers: Bild, Sueddeutsche Zeitung (SZ) and Rheinische Post (RP). Bild and SZ are the top two most read newspapers in Germany in terms of number of subscribers with Bild having 5.51 million daily unique users (Bild, 2022) and SZ having 1.33 million

subscribers in 2022 (Axel Springer, 2022). Given the reach of non-academic publications, it is advisable to include tabloids and soft news in a sentiment analysis (Vicsek, 2011). Soft news shows the highest engagement rate and thus has a greater reach compared to scientific papers and hard news (Vicsek, 2011). For this reason, we have selected SZ as a newspaper with rather hard news and the tabloid newspaper Bild reports on soft news more often than hard news. At the same time, we wanted to analyse a regional newspaper as well to compare and contrast the differences between the articles published on regional and national level. For this reason, we opted for RP – since it is one of the biggest local newspapers in North Rhein-Westphalia, the most populous province of Germany.

We analyse the time period from 2010 to 2022 and select this time frame for reasons of data availability. For our initial analysis, we searched for the term "artificial intelligence" or "Künstliche Intelligenz" in either the title or main text of the article. The search was then extended to a variation of words related to AI and algorithms, which can be seen in Table 11.1. We used a web scraping tool from R to access the articles from each website after getting paid subscription for the newspapers. The web scraping tool allowed us to download article titles, text and respective dates on which the article was posted.

Table 11.1: List of keywords for AI-related article search (Fischer & Puschmann, 2021).

AI and algorithm-related keywords
ADM
Algorithmus
Algorithmen
Algorithmische Entscheidungen
Artificial Intelligence
Automatisierte Entscheidungsfindung
Künstliche Intelligenz
KI
Maschinelles Lernen
Machine learning
Maschinenlernen
Maschinenlernverfahren

To ensure that only articles that address the topic of artificial intelligence were captured, we tried different variations of the keyword artificial intelligence. For example, we checked for "artificial intelligence", "artificial AND intelligence", "artificial OR intelligence" etc. The "AND" and "OR" research functions allowed us to separate articles that were captured by the web scraping tool but only contained one of the two words from the keyword "artificial intelligence". This means that we were able to omit articles that discussed only "artificial" or "intelligence".

A total of 11,319 articles from all three newspapers combined were identified from the selected keywords and downloaded. The downloaded articles were checked for duplicates (based on the title of the news); as a result, 9487 articles remained in the final dataset. We also observed that in some cases, AI or algorithms were not exactly the theme of the article, even though the keyword was mentioned in the text. For example, in one instance, the article was identified as AI-related because it included a sentence "*The minister president said that Germany needs to invest more in artificial intelligence*" while the rest of the article was about the political policy of the said minister president, not focusing on AI at all. This led us to develop additional filter to ensure that the articles we are including in our analysis were indeed about AI.

As a first filter, we counted the number of times each keyword was appearing in each article. If it was only appearing once, the article was removed from the sample. If the keyword or a combination of keywords were appearing more than once, the articles were kept. We then did a second robustness check by manually selecting (randomly) and reading articles from our sample to ensure that they were indeed about the theme of AI or algorithms. A total of 45 articles (15 from each newspaper) were tested randomly. As a result of both checks, our sample size reduced significantly (from 9487 observations to 2240 observations). We discuss the data for each newspaper individually in more detail in the next section. Figure 11.1 gives a summary of the process.

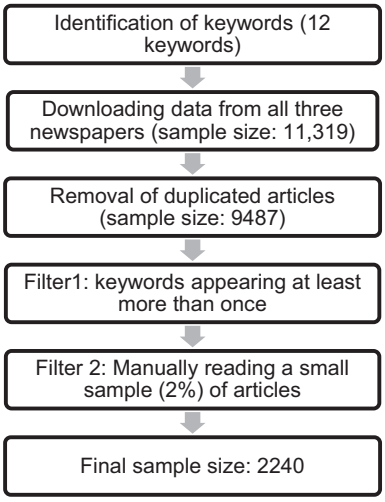

Figure 11.1: Data collection process. (compiled by authors.)

11.3.2 Summary of Data

Our sample size indicates that the highest number of articles published on the theme of AI and algorithms were published in the SZ (1589 articles), followed by the RP (351

articles). Bild published the lowest number of articles (300) between 2013 and 2022, as can be seen from Figure 11.2.

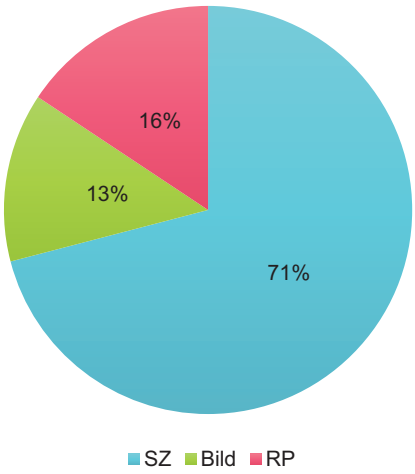

Figure 11.2: Share of articles on AI and algorithms between Bild, SZ and RP between 2013 and 2020.

Contrary to the conclusions drawn by Garvey and Maskal (2019), our data indicates an increase in newspaper articles from 2013 onwards, which peaked in 2019 (see Figure 11.3). Since 2019, the interest of newspapers in AI-related topics seems to have decreased relatively. One reason behind this could be the increasing ubiquity of AI; the term is taking a back seat in favour of terms related to concrete applications for example Chat-GPT3, DALL-E or other similar terms. The highest number of articles published were in 2018 and 2019, which could be attributed to the scandals related to Amazon and Facebook–Cambridge Analytica that became the talk of the town around that time. It is also interesting to see that in the case of Bild, the publication of AI-related articles remained steady between 2016 and 2019 while it increased drastically for SZ and increased only somewhat for RP.

When looking at the frequency of articles published on monthly basis, it was very interesting to observe that for all three newspapers, the average number of articles decreased in the month of August while the peeks differ significantly across the newspapers (for SZ and Bild, the highest number of articles published were in the months between October and December while for RP it was between May and June).

11.3.3 Sentiment Analysis

To answer our second research question, we opted for a sentiment analysis approach by making use of the syuzhet package (Jocker, 2020) in R, which makes use of four different dictionaries along with natural language processing techniques to determine

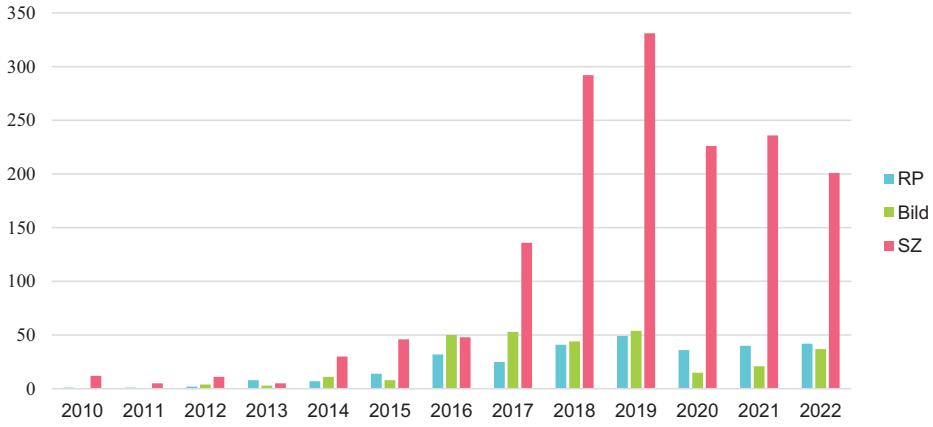

Figure 11.3: Annual number of articles on AI and algorithms published in selected newspapers.

the sentiment tone of the text. We used the "NRC" dictionary developed initially by Mohammad and Turney (2010) for the analysis since it allows us the flexibility of checking the text in German language, something that is not offered in other three dictionaries in the syuzhet package.

We wanted to examine the overall emotional tendency of the text and so we opted for calculating the mean sentiment score per article. On average, a score close to –1.0 indicates a negative sentiment of the text while a score of +1.0 indicates a positive sentiment. A score of 0 or close to zero usually means that the text is neutral. The score generated by the software was also manually checked – each member of our team randomly selected ten articles to read and compare the score to that generated by R. In almost all the cases, the manual score and that generated by R was similar.

11.3.3.1 Sentiment Score

Our results show that majority of the articles (around 86% of all articles) in all three newspapers have a positive sentiment while a very small percentage (around 1.5% of all articles) can be classified as neutral. Figure 11.4 summarises the results across different newspapers.

The highest percentage of articles with a negative tone was found in Bild (12.67%), followed by SZ (11.91%) and RP (9.69%). On the other hand, RP led the way in articles with an average positive tone (88.3%), closely followed by Bild and SZ (both at 86%). The share of neutral articles was very low. The highest number of articles were published in SZ (2.08%), followed by RP (1.99%) and Bild (1.33%). These results are relatively different from those of Fischer and Puschmann (2021) who found no articles with a negative tone for Bild and a larger percentage of neutral articles for SZ. Since

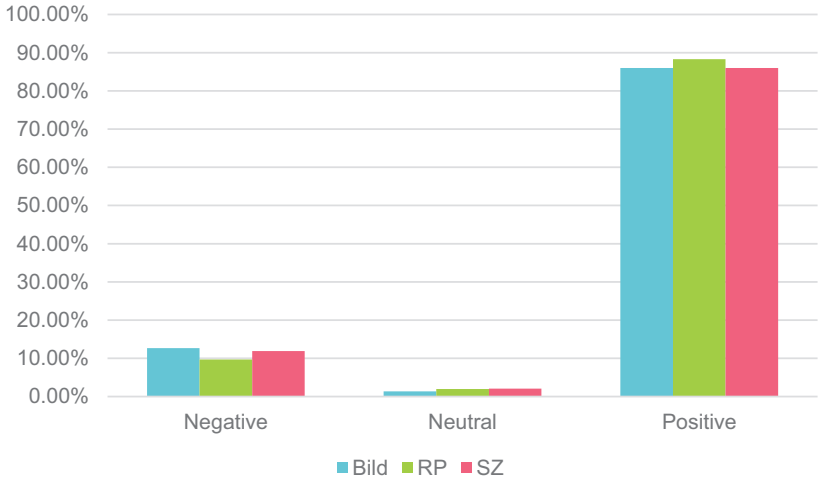

Figure 11.4: Percentage of articles with negative, neutral and positive sentiment scores per newspaper (authors' own calculation).

the report by Fischer and Puschmann (2021) does not explain what dictionary and/or method it is using to calculate the sentiment score, it is difficult to clarify the reasons behind such a big difference.

In addition to looking at the sentiment score as a percentage of articles per newspaper, we also calculated the average sentiment score for each newspaper. We found that on average, all three newspapers have a sentiment score of between 0.37 and 0.41, indicating that the German newspapers have reported somewhat positively on AI and algorithms over the years.

11.3.4 AI and Consumers

Apart from checking the sentiment score for newspaper articles on AI and algorithms, we also wanted to examine the extent to which newspapers in our sample related AI and algorithm topics to consumers, consumer protection and consumer-associated application or issues. For this purpose, we defined a new set of keywords for consumers and consumer-related issues based on our understanding of the literature (see Table 11.2) and searched for them in our sample of 2240 articles. Once again, we used the same criteria as earlier: if the keyword is appearing more than once in the text, we consider it, otherwise the text is dropped.

Table 11.3 summarises our results. In general, we observe that around 30% of the total articles on AI, for each newspaper, discussed consumers or consumer-related issues. We also checked for words like discrimination and fairness in connection with consumers in the article text and found that it is not that intensively discussed in the

Table 11.2: List of keywords for consumer-related article search (authors' own compilation).

Consumer keywords
Diskriminierung
diskriminieren
Fairness
fair
Intransparenz
Käufer
Konsumenten
Konsument
Kunden
Nachfrage
Nutzer
Transparenz
Verbraucher
Verbraucherentscheidungen
Verbraucherschutz
Vertrauen

newspapers. A comparison of the average sentiment score of the articles that discuss consumers and AI with the overall data sample shows that it does not change that much. This indicates that newspapers do not treat themes like consumers, consumer protection, fairness and discrimination any differently than other themes and do not specifically focus on it as well in their reporting.

Table 11.3: Sentiment score for AI and consumer-related articles (authors' own calculation).

Newspaper	Articles about AI and algorithms	Sentiment score	Articles about AI, algorithms and consumers	Sentiment score
SZ	1589	0.38	507	0.29
Bild	300	0.37	90	0.43
RP	351	0.41	108	0.36

11.4 Discussion of Results and Public Opinion

The main conclusion that we can draw from our results so far is that newspapers in Germany are relatively optimistic about AI and algorithm-related topics and present a fairly positive picture to their subscribers as well. However, studies have indicated that negative news have a higher impact on readers than positive news leading to feelings of distrust (McIntyre & Gibson, 2016), emotional instability and apprehension

about potential harm to one self (Aust, 1985; Mclntyre & Gibson, 2016). Therefore, the important question is that how does the public in Germany perceive these themes? Does positive reporting have an impact on acceptance of these technologies among the public? We examined different public polls and found that public opinion is relatively mixed but is more inclined in a positive direction. For example, in a survey conducted by TÜV-Verband in 2019, the participants were asked *how do they feel about AI?* (TÜV-Verband, 2021). Almost 46% of the participants responded positively (TÜV-Verband, 2021). When the survey was repeated again in 2021, the positive response increased to almost 51% (TÜV-Verband, 2021). Similarly, Bertelsmann Stiftung conducted a poll in 2022, asking "*What do you think of when you hear the term 'algorithm'/'artificial intelligence'*?" (Overdiek & Petersen, 2022). More than 50% of the participants answered that they link it to *progress* and *accuracy*. However, many of them (around 51%) also thought of it as *scary* and *dangerous*. When it comes to relaying on AI to get information or to share personal information with AI, the response of the public changes as can be seen by the poll conducted by KPMG in 2020 where 39% of the respondents were unwilling to rely on AI for information purposes (Gillespie, Lockey & Curtis, 2021).

Altogether, it is obviously difficult to prove that positive sentiments in the newspapers have resulted in a more positive attitude of the public for some aspects of AI and algorithmic systems. However, it is clearly visible from our analysis that the general attitude of the newspapers as well as the public is accepting of the new technologies. It would however be more beneficial if newspapers discuss AI in relation to its impact on consumers more often. If consumers have more information about the usage and implementation of AI and algorithms, it is possible that the *scary* and *dangerous* sentiment that was observed in some polls can be reduced.

We understand that our research is not without limitations. To begin with, it is difficult to identify one (or a set of defined) terms for artificial intelligence and algorithms that is used by newspapers which makes it difficult to select relevant keywords as discussed in Section 12.2. However, we considered a diverse set of keywords to make the analysis as comprehensive as possible and would like to extend our research in the future by including context-based sentiment analysis. We are also aware of the fact that the three chosen newspapers might not be representative of overall media of Germany but we do strongly believe that the newspapers in our sample do represent a certain stratum of German population and their opinion. That being said, our research results can add to the literature discussing the role of media in general and newspapers in particular to improve the overall impression of new technologies like AI on the public.

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