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Nomos

Understanding the Multifaceted Power of Playing

Jens Junge | Karin Falkenberg |
Rudolf Inderst | Jochen Koubek [Eds.]

Spielforschung

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Playing is a primal phenomenon of nature, life and people. This 'matter of course' has only been rudimentarily researched to date. In this handbook, researchers on this subject from across the social sciences and humanities come together for the first time to provide an insight into the diverse aspects of playful phenomena from their respective perspectives: from imaginative playing with toys and board games to digital games and eSports. Playing is far more than just entertainment and a pastime. Language development, personality development, character development, social and ethical skills and, last but not least, the capacity for democracy are all developed through playing and make the topics covered in this book interdisciplinary.

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FULL PAPER

Journalistic quality in the eye of the beholder: An eye-tracking study on user comments and their effect on journalistic quality perception

Journalistische Qualität im Auge des Betrachters: Eine Eye-Tracking-Studie zu Nutzendenkommentaren und deren Auswirkung auf die Wahrnehmung journalistischer Qualität

Maximilian Eder, Katharina Pohl & Annika Sehl

Maximilian Eder (Dr.), Department of Media and Communication, LMU Munich, Akademiestraße 7, 80799 Munich, Germany. Contact: maximilian.eder@ifkw.lmu.de. ORCID: https://orcid.org/0000-0001-9055-4223
Katharina Pohl (Dr.), Fraunhofer Society, Hansastraße 27c, 80686 Munich, Germany. Contact: katha-pohl@gmx.de. ORCID: https://orcid.org/0000-0002-4172-7121
Annika Sehl (Prof. Dr.), Department of Journalism, Catholic University of Eichstätt-Ingolstadt, Ostenstraße 25, 85072 Eichstätt, Germany. Contact: annika.sehl@ku.de. ORCID: https://orcid.org/0000-0002-8949-569X

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Abstract: User comments have emerged as a prominent feature accompanying news articles, which has changed how audiences interact with journalistic content. While offering options for reader engagement and community building, previous research has shown that these comments also significantly shape readers' perception of an article's journalistic quality. The study extends this research strand with survey data on audience perception and eye-tracking technology in an experiment. This design allows for (1) analyzing eye movement data to gauge the attention paid to user comments and (2) how the presence, tone, and content of these comments influence readers' perception of overall quality. The results show that high-quality articles are more likely to captivate readers' interest and maintain their attention throughout the reading process than low-quality ones. Moreover, positive reader comments affect the perception of specific journalistic quality dimensions (e.g., transparency and diversity), while negative comments garner more attention. The findings shed light on this complex interaction between user comments and journalistic quality perception, offering valuable insights for journalists, news organizations, and online platforms striving to optimize the reader's experience while upholding journalistic standards.

Keywords: Eye tracking, journalistic quality, quality perception, user comments

Zusammenfassung: Nutzendenkommentare haben sich zu einem wichtigen Bestandteil von Nachrichtenartikeln entwickelt und damit die Art und Weise verändert, wie das Publikum mit journalistischen Inhalten interagiert. Während sie Möglichkeiten zur Leserbindung und zum Aufbau von Communities bieten, haben frühere Untersuchungen gezeigt, dass diese Kommentare auch die Wahrnehmung der journalistischen Qualität eines Artikels maßgeblich beeinflussen. Die Studie erweitert diesen Forschungsansatz um Umfragedaten zur Wahrnehmung des Publikums, und mithilfe von Eye-Tracking in einem Experiment. Dieses Design ermöglicht es, (1) anhand der Augenbewegungsdaten zu analysieren, wie viel Aufmerksamkeit den Nutzendenkommentaren geschenkt wird, und (2) zu untersuchen, wie die Präsenz, der Ton und der Inhalt dieser Kommentare die Wahrnehmung der Gesamtqualität durch die Lesenden beeinflussen. Die Ergebnisse zeigen, dass hochwertige Artikel eher das Interesse der Lesenden wecken und ihre Aufmerksamkeit während des gesamten Lesevorgangs aufrechterhalten als Artikel von geringer Qualität. Darüber hinaus beeinflussen positive Nutzendenkommentare die Wahrnehmung bestimmter Qualitätsdimensionen (z. B.

Transparenz und Vielfalt), während negative Kommentare mehr Aufmerksamkeit auf sich ziehen. Die Ergebnisse beleuchten diese komplexe Wechselwirkung zwischen Nutzendenkommentaren und der Wahrnehmung journalistischer Qualität und bieten wertvolle Erkenntnisse für Journalistinnen und Journalisten, Nachrichtenorganisationen und Online-Plattformen, die anstreben das Leseerlebnis zu optimieren und gleichzeitig journalistische Standards aufrechtzuerhalten.

Schlagwörter: Eye-Tracking, journalistische Qualität, Qualitätswahrnehmung, Nutzendenkommentare

1. Introduction

The rapid expansion of online news and social media platforms like Facebook, Instagram, and TikTok has transformed how (online) audiences consume and engage with journalistic content. News articles are no longer limited to being discussed among journalists and editors; instead, they have become interactive spaces where readers can actively participate through making comments (Springer et al., 2015), reading other users' comments, and shaping the narrative on issues by expressing their opinions (Wendelin et al., 2017). In short, user comments are a prominent feature accompanying online news articles.

While user comments certainly offer an avenue for reader engagement and community building, previous research demonstrates that they also have a profound impact on readers' perception of journalistic quality (Kümpel & Unkel, 2020; Prochazka et al., 2018; Weber et al., 2019). Further, the perceived credibility of news articles – measured using similar criteria as for journalistic quality (e.g., accuracy and impartiality) (Appelman & Sundar, 2016) – can be reduced when juxtaposed with critical user comments (Naab et al., 2020; Waddell, 2018). Consequently, understanding how user comments influence readers' perception of journalistic quality becomes crucial in a digital news environment.

Therefore, this study aims to explore the relationship between user comments and readers' perception of journalistic quality, which can be investigated using survey data regarding the audience's perception of journalistic quality and readers' visual attention patterns as they engage with online news articles and the accompanying user comment section through eye-tracking technology.

The research objectives are twofold. First, to investigate the extent to which readers actually pay attention to user comments by analyzing eye movement data: Understanding the visual attention to user comments is crucial for discerning their potential impact on readers' overall perception of journalistic quality. Second, to examine the influence of user comments on readers' perception of journalistic quality; manipulating the tone of user comments, enables assessment of how comments affect readers' perception of overall journalistic quality.

By applying eye-tracking technology, the findings will contribute to understanding the complex interplay between user comments and readers' perception of journalistic quality, which provides valuable insights for journalists, news organizations, and online platforms seeking to optimize the reader experience while maintaining high journalistic standards.

2. Literature Review

2.1 Journalistic quality from an audience perspective

The concept of journalistic quality has been a long-standing issue among scholars, with German researchers in particular having participated in the debate of defining the concept (Urban & Schweiger, 2014, p. 823). The complexity of developing a universally accepted and comprehensive definition arises from the need to consider various perspectives, including those of different groups (e.g., the audience, media practitioners, and legal experts), as well as the selection of appropriate reference points (e.g., target groups, functions of journalism, and sources) when trying to define journalistic quality. Urban and Schweiger (2014, p. 822) conclude that there "is no quality in an item itself, but only some kind of convention to interpret certain objective indicators as high or low quality."

The consensus of the heterogeneous discourse in journalism practice and academia is that journalistic quality is a multidimensional construct that relates to the normative functions of journalism in democratic societies (see e.g., Strömbäck, 2005). At the same time, Bucher (2003, p. 12) proposes a constructivist perspective, asserting that qualities are subjective constructs that can vary from individual to individual. This viewpoint highlights the inherent subjectivity in perceiving journalistic quality, emphasizing the influence of personal perceptions and biases. Given the impracticality of developing individual quality standards, the emphasis has shifted toward categorizing journalism types and media genres. This approach serves as a compromise between an overly narrow and a generalized perspective (Engesser, 2013, p. 459). This categorization process has led to operationalizing and measuring journalistic quality through a catalog of normative quality criteria (Urban & Schweiger, 2014). Against this background, another fundamental question emerges regarding whether the audience can recognize or evaluate the journalistic quality and to what extent (see among others, Jungnickel, 2011; Urban & Schweiger, 2014).

The digital age has introduced further challenges in understanding journalistic quality. Research now has to consider a more comprehensive array of media genres, fragmented audiences, and diversification within journalism than ever before. While normative discussions about quality remain relevant, the audience perspective has gained significant prominence (Jandura & Friedrich, 2014; Strömbäck, 2005) and led to a downright "audience turn" (Costera Meijer, 2020) in journalism. The criteria that fundamentally shape the perception of journalistic quality from the audience perspective are contingent on a range of factors, including individual characteristics such as education, media consumption habits, subject knowledge, and the medium itself (Geiß, 2020; Jungnickel, 2011). These varying factors further underscore the nuanced nature of audience perceptions.

In line with the analog letter to the editor, digital journalism users can express their perception of journalistic content through comments (e.g., Fletcher & Park, 2017, pp. 1285–1286; McCluskey & Hmielowski, 2011). The perceived quality by users is not only an expression of one's own opinion but also influences the

evaluations of journalistic content made by others (Kümpel & Springer, 2016; Kümpel & Unkel, 2020; Prochazka et al., 2018).

2.2 Influence of user comments on perceived journalistic quality

Online comment sections revolutionized the audience's participatory discourse by limiting the hurdles to interacting with the media organization and other audience members. In this context, user comments are a "subcategory of media-stimulated interpersonal communication that is published directly below news items on news websites or on news media presences within other online communication services" (Ziegele et al., 2014, pp. 1112–1113). Given that many news organizations have had comment sections for as long as they have been online, it is not surprising that they remain the most common participation feature on news organizations' websites in Germany (Niemann et al., 2021) and that they are regularly used by readers. Ziegele et al. (2017, p. 324) state that about one quarter of German online users write comments at least once a month on the websites of established news media, and Reimer et al. (2023, p. 1332) even conclude that between a quarter and half of users have commented on a news story at least once. In their study, Schultz et al. (2017, p. 251) found that 5 percent of respondents who rarely use the internet to keep up with current events comment very often or often on posts of legacy news media websites.

However, many news organizations have agonized over the value of the conversations that rage in the space below a story. There is an ongoing debate over the issue as newsrooms struggle with moderation and "dark participation patterns" of audience members using abusive language or hate speech (Frischlich et al., 2019, pp. 2015–2016). As a result, prominent daily newspapers in Germany like *Süddeutsche Zeitung* and *Frankfurter Allgemeine Zeitung* have closed or overhauled their comment sections – although it seems this is not an overwhelming trend – and tried to shift such discussions to social media platforms (Kim et al., 2018). Other possibilities to address the problems mentioned above are to close comment sections after a certain amount of time or not to allow comments on critical topics (e.g., terror attacks, rape, and war).

Previous research has shown that "[c]omments seem to influence both how individuals perceive the topics/issues covered in media content as well as how the content itself is evaluated" (Kümpel & Unkel, 2020, p. 89; for an overview, see Ksiazek & Springer, 2018). The effects of evaluative comments on readers could be explained using information-processing theories (Prochazka et al., 2018, p. 65). In the context of information overload, for example, in digital news environments, individuals are more likely to process the information in a peripheral way, relying on heuristic cues such as social information (e.g., comments, likes, and shares), which influence the perceived credibility of journalistic content (Naab et al., 2020) or the perception of the quality of news articles (Kümpel & Springer, 2016; Prochazka et al., 2018; Prochazka & Obermaier, 2022). At the same time, the psychological processes through which such effects occur remain undertheorized (Lee et al., 2021) and only a few scholars have investigated the relationship between user comments and perceived journalistic quality.

The findings from two online experiments by Dohle (2018) indicate that participants exposed to positive user comments tend to evaluate the journalistic coverage more favorably in terms of transparency, impartiality, and completeness compared to those exposed to negative comments.[1] Additionally, the study examined the evaluation of a high-quality journalistic news clip compared to a low-quality version. It was observed that the high-quality version received, on the whole, better quality ratings than the low-quality one. The overall quality of the news report was more positively evaluated when accompanied by positive user comments instead of negative ones.

In their investigation into whether unreasonable comments diminish the perceived information quality of an article, Prochazka et al. (2018) find that the presence of uncivil comments negatively impacts the perceived formal quality of an article. This effect, however, is observed primarily in the context of lesser-known news brands. Further, the mere existence of comments, irrespective of their tone or content, appears to lower the overall perceived quality of an article.

Research conducted by Kümpel and Springer (2016) demonstrates that user comments that specifically address the impartiality and accuracy of journalistic content consistently and significantly affect readers' perceived quality. When user comments lauded a news article for its impartiality and balance, it resulted in readers perceiving the article as being of higher quality in terms of impartiality. Additionally, although to a somewhat lesser extent, it also positively influenced perceptions of accuracy. A similar effect was observed for the perception of accuracy. When user comments emphasized that the article contained no errors or contradictions, readers perceived it as more accurate and, once again, as more impartial. Consequently, affirmations regarding the content within user comments generally lead readers to regard a news article as being of higher quality, irrespective of whether those comments explicitly address the article's impartiality or accuracy.

2.3 Eye movements and attention patterns

Tracking eye movements allows for concretizing the effect of media reception and visual stimuli, for which self-reporting methods cannot provide data or can only do so to a minimal extent (Geise, 2011, p. 160). As Bucher and Schumacher (2006, p. 352) state: "Eye movements are not the result of a simple automatic sensory mechanism, but are interrelated with a person's actions: They are actively used for exploring the environment as directed by a person's intentions."

To implement eye tracking into communication research, it is essential to consider the multidimensional construct of attention, as it is a precondition for further information-selection processes that inhibit or foster news selection behavior. According to Donsbach (2004, p. 147), the concept of news selection can be viewed as a multidimensional construct that includes attention, perception, and

1 Perception and evaluation of journalistic quality are considered two interdependent and sometimes synonymously applied concepts.

retention, all of which play a role in the selection process. Therefore, Sülflow et al. (2019, p. 174) conclude that:

> *Attention allocation can be seen as an indicator of more elaborate cognitive processing. Thus, if people fixate on content more intensively, it is more likely that they think about the content more thoroughly and process it more elaborately than content that is not or only shortly fixated upon.*

According to Smith et al. (2007; see also Engelmann et al., 2021, pp. 782–783), there is also a distinction to be made between selective attention and selective exposure. Selective attention refers to the specific aspect of a stimulus that captures attention. In contrast, selective exposure pertains to the outcome of the decision-making process in selecting what content to engage with.

Attention and selection processes are inherently subjective and not directly observable phenomena. These processes become discernible only through observing a series of consecutive actions, allowing us to ascertain what has been selected as the object of attention and the extent of attention allocation. Eye movements represent a significant indicator of these activities (Rayner, 1998, pp. 374–375).

These movements comprise at least three integral structural elements (Geise, 2011, pp. 167–171): (1) fixations as the concentrated focusing of the fovea onto a specific perceptual object where attention is likely to be allocated; (2) saccades, which play a crucial role in preparing the alignment of the eye for foveal focusing on the object and typically transition into a fixation, and (3) micromovements (especially microsaccades), which are mainly undirected and primarily serve the physiological control of fixation. Especially fixations and saccades of the eye on a given stimulus are important parts of visual attention, which itself is positively correlated with information processing, "as such attention makes content accessible for further processing in working memory" (Greussing et al., 2020, p. 809; see also Kruikemeier et al., 2018, p. 76).

3. Research question and hypotheses

As shown in the literature review, the influence of user comments on the audience's perception of journalistic quality has been the topic of various studies (e.g., Dohle, 2018; Kümpel & Springer, 2016; Prochazka et al., 2018). At the same time, as there is no direct access to people's subjective perception of such comments, eye tracking provides insights to validate users' self-reported cognitive processes to further explore the relationship between user comments and the audience's perception of journalistic quality. If attention allocation is an indicator of cognitive processing, visual attention affects the perception of user comments and the evaluation of journalistic quality. Therefore, the research question (RQ) is as follows:

> *RQ: To what extent do participants pay attention to a news article and its accompanying user comments?*

Readers focus on certain information, especially emotional information, which draws unconscious attention from the audience (Yiend, 2010). The extent to

which positive or negative information attracts attention is under debate. For example, findings by Kätsyri et al. (2016) on the effects of negative social media messages in media multitasking indicate longer viewing times than positive ones. A recent eye-tracking study by Kohout et al. (2023) indicates that visual attention is higher for negative than positive comments under heuristic processing conditions. Moreover, better recognition of story details was displayed when angry comments were present, compared to fearful ones. Therefore, it is hypothesized that:

> *H1: Readers are more likely to pay attention to negative comments than positive ones.*

Further, experimental studies have shown that media users can differentiate high-quality articles from low-quality ones (Jungnickel, 2011; Urban & Schweiger, 2014). It has also been observed that user comments can influence readers' perception of journalistic quality and specific quality dimensions. For instance, Dohle (2018) and Kümpel and Springer (2016) found that journalistic coverage accompanied by positive user comments tends to receive better evaluations than coverage with negative comments addressing specific quality aspects. Therefore, this leads to the second hypothesis:

> *H2: Positive reader comments positively influence the perception of journalistic quality dimensions.*

4. Method

4.1 Procedure, measures, and stimuli

Eye tracking is defined as "a process-tracking method that allows researchers to monitor the position (fixation, defined as the maintaining of the visual gaze on a single location) and movement of the eyes and thus to objectively assess news consumers' visual behavior" (Greussing et al., 2020, p. 811). Although it has been used as a method more frequently in the past decade (King et al., 2019, p. 156), it is (still) not a standard instrument in communication science. To improve the transparency of the research process, this study largely follows the guidelines for eye-tracking research by Fiedler et al. (2019).

In the present study, eye tracking was used to record the visual perception of user comments as a stimulus. Therefore, 13 areas of interest (AOIs) were defined for each article and its user comments to distinguish between visual attention directed at (1) different parts of the text and (2) the comments (available as a supplement). Within these AOIs, several commonly discussed visual attention research variables were analyzed (e.g., Geise, 2011; King et al., 2019).

A Tobii Pro Nano eye-tracking device was used to observe and analyze participants' gaze patterns on both the text and comments with a sampling rate of 60 Hz. The eye tracker was mounted on a 17-inch screen with a 1920 × 1080-pixel resolution. Sitting at a desk in front of the screen in a dedicated room for the experiment, participants could move their heads naturally without any equipment

restricting their movements. The distance between participants and the screen was continuously monitored throughout the session.

The participants were randomly assigned to a 2 x 2 between-comments experiment (see Table 1). The experiment itself took place over two academic terms to extend the overall sample: over 02.02.2021–17.02.2021 and 18.05.2021–02.06.2021. The whole procedure took about 20 minutes per participant, in addition to the survey (M = 11.45 min, SD = 12.17 min). No incentive or compensation was given. After the experiment, the participants received a debriefing (i.e., indicating the manipulation of the article and user comments).

A nine-point calibration procedure was employed to ensure accurate eye movement measurement. As there is no gold standard for data selection regarding eye tracking (Holmqvist et al., 2011, p. 141), the recommendation by Conklin et al. (2018, p. 24) was followed, setting the calibration deviations between 0.5 and 1 degrees. During calibration, participants were instructed to follow a dot displayed on the desktop screen, thus ensuring precise eye movement tracking. Participants were then provided with a brief explanation displayed on the screen and instructed to proceed by clicking "next" to access the news article with a total of five user comments, which contained either a positive or negative sentiment regarding the article, and which were written from scratch for the purpose of the experiment.

The news article used in this study was designed based on a real-world news story from the website of *Der Spiegel*, a highly trusted news magazine in Germany (Behre et al., 2025, p. 85) and one associated with good-quality journalism (Horz-Ishak & Thomass, 2021, p. 226).[2] Several modifications were made to ensure the distinctiveness of the stimulus, such as removing the news organization's name, changing the reporter's name, and changing the header's color while retaining the text's image and font. Moreover, the article was altered in accordance with the experiment by Dohle (2018), meaning that the text was altered with the help of students with a journalism background by introducing factual errors or giving incomplete information. In the high-quality version, the proposed quality criteria were effectively met. Conversely, certain aspects of the referenced article were incomplete in the low-quality rendition. This latter version's depictions of the issue were marred by incompleteness, inaccuracies, and elements that could be perceived as speculation.

To enhance participant recognition and familiarity, the news topic chosen for this study related to the potential implementation of a speed limit on Germany's Autobahn network. At the time of the experiment, leaked proposals by the federal government regarding speed restrictions had sparked significant public controversy. A government-appointed committee on the future of mobility was actively working on a proposal suggesting the introduction of a 130 kph (80 mph) limit to help Germany meet EU emissions targets. Although the issue of speed limits is frequently intertwined with climate change debates, German citizens and the country's influential automotive industry often criticize imposing a general speed limit. In this specific case, even Germany's transport minister, Andreas Scheuer of

2 The original article can be accessed here: https://www.spiegel.de/auto/deutscher-verkehrssicherheitsrat-fordert-tempo-130-auf-autobahnen

the Christian Social Union (CSU), vehemently opposed the idea, ultimately leading to the federal government rejecting the proposal.

Every news article in the experiment was supplemented with five user comments. In both versions, whether the comments were positive or negative, one comment offered a slightly contrasting viewpoint. The comments in both versions were nearly identical in length, with 30 words on average. The negative comments primarily focused on critiquing the article's transparency, completeness, and accuracy, maintaining a respectful tone without resorting to vulgar or aggressive language (e.g., "There are at least as many arguments against a speed limit as there are for it, but they are always left out. One-sided reporting!!!").[3] Conversely, the version dominated by positive comments featured users responding favorably to the information presented in the article or to the article itself (e.g., "Thank you for this article, which presents facts instead of lobbying. The figures help [you] form your own opinion."). The comments were based on existing user comments and underwent pretesting for sentiment by other students.

4.2 Additional measures

For evaluation of the perceived journalistic quality, the study relied on self-report data obtained via an online survey after reading the stimulus material, as "eye tracking alone provides no or only little potential for answering questions such as [...] what the recipients think or feel while observing the visual stimulus" (Geise, 2011, p. 151). A pretest of the questionnaire was carried out, which combined verbal probing techniques (e.g., comprehension and specific probes) and retrospective thinking aloud (Willis, 2018).

Therefore, participants were asked how they perceived the article's journalistic quality: Overall (i.e., "Overall, I consider the quality of the article to be good.") and using statements in accordance with seven items that represent different quality dimensions (Dohle, 2018; Urban & Schweiger, 2014). Both were measured with a five-point Likert-type scale (e.g., "Please rate the quality of the article based on the following statements: This article contains accurate information: 1 = strongly disagree to 5 = strongly agree").[4] The seven quality dimensions were defined as follows:

First and foremost, journalistic coverage should encompass a broad spectrum of social groups and ideas, allowing for the representation of diversity (i.e., "This article contains diverse information"). Second, news should center around current and socially significant topics, highlighting their key aspects to maintain relevance (i.e., "This article contains relevant information"). However, the value of this information lies in its accuracy, which is fundamental for citizens to comprehend societal issues and formulate informed opinions and decisions (i.e., "This article contains accurate information"). Equally critical is ensuring that the recipients readily understand this information, emphasizing comprehensibility (i.e., "This

3 Comments presented here are translated to English

4 Survey questions are translated into English here; the questionnaire and stimuli in German are available upon request.

article contains comprehensible information"). Further, for journalism to empower citizens to make competent and unbiased judgments, it must uphold the principles of impartiality, offering neutral and balanced reporting on all facts, claims, and positions (i.e., "This article contains impartial information") and provide transparency by divulging insights into the journalistic processes and story creation (i.e., "This article contains transparent information"). Ultimately, adherence to ethics is the ultimate dimension for quality news reporting (i.e., "This article reports are ethically responsible").

4.3 Participants

A total of 145 participants took part in this study, 76.6 percent of whom self-identified as male and 23.4 percent as female. The age range was between 19 and 41 years (M = 24 years; SD = 3.297); 60 percent of participants had at least a high school diploma,[5] and about 30 percent had a BA degree. A total of 65.2 percent were interested or very interested in comments on digital platforms (e.g., social media and online news websites). However, 84.1 percent stated they had not commented on journalistic articles in the previous six months.

The participants were recruited by students from two MA media and management studies courses in 2020 and 2021 at a German university, mainly among their peers, and randomly assigned to one of the four experimental conditions. Although an equal sample size of experimental groups is deemed optimal, the availability of participants is often influenced by circumstances beyond the researchers' control (Cohen, 1988, p. 207) and other obstacles such as the no-show behavior of individuals (Amberger & Schreyer, 2024), resulting in slightly unequal sample sizes (see Table 1).

Table 1. Frequency of experimental conditions

Article Design	Participants	Percentage
High article quality/negative comments	42	29.0
High article quality/positive comments	33	22.8
Low article quality/negative comments	34	23.4
Low article quality/positive comments	36	24.8
Total	145	100

It is worth noting that the choice of predominantly student participants in eye-tracking studies is commonly observed, as highlighted in a meta-analysis by King et al. (2019, p. 157). Moreover, the sample size for this study exceeds the average size typically observed in eye-tracking studies (King et al., 2019, p. 155).

5 Sekundarbereich II (Gymnasium, integrierte Gesamtschule, Fachoberschule, Berufsschule)

5. Findings

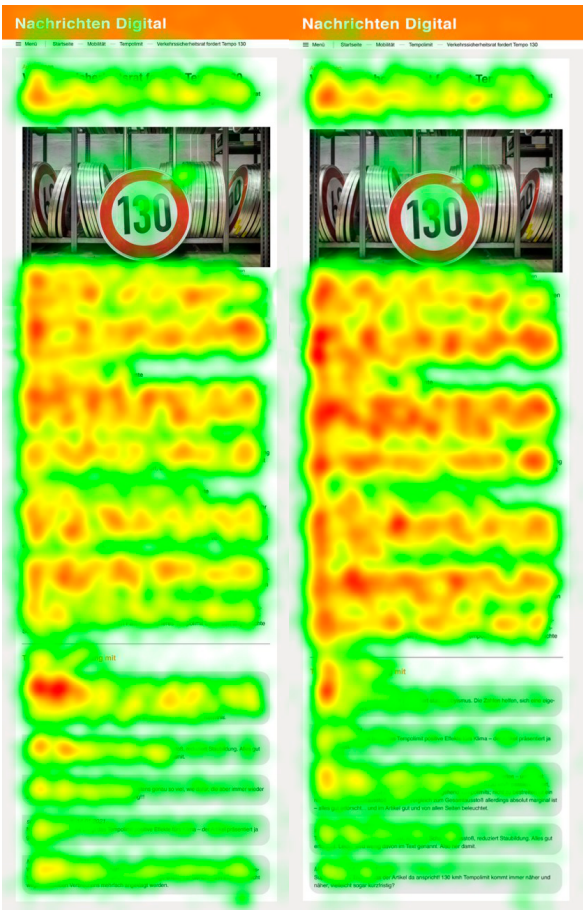
The RQ pertains to the participants' level of visual attention directed at the various segments of the news article and its accompanying user comments. This data was extracted from the aggregated gaze visualization, offering a visual representation of combined fixations from multiple viewers on defined AOIs.

Heat maps enable data visualization of the attention-capturing sections and elements of the news article by using a range of warm and cold colors. The default settings from the Tobii I-VT (Fixation) gaze filter were used across the study with a radius of 50 pixels, corresponding to a total kernel of 100 pixels. The setting type selected was absolute count. The maximum scale value was 15.00 counts. The red areas on the heat maps indicate the sections the participants looked at particularly intensively (see Figures 1 and 2).

Figure 1. Overview of heat maps for high article quality

Note. Negative comments (left), positive comments (right); Photograph: Florian Gaertner/Photothek Media Lab/Imago.

Figure 2. Overview of heat maps for low article quality



Note. Negative comments (left), positive comments (right); Photograph: Florian Gaertner/Photothek Media Lab/Imago.

The heat maps show that the participants concentrated primarily on the textual areas of the stimuli. Hardly any attention was paid to the image – across all four stimulus variants – with only the 130 kph speed limit sign receiving occasional attention. The image was viewed for an average of 4.35 seconds. The headline was also apparently only skimmed, with participants focusing on it for an average of 2.64 seconds.

Regarding the rest of the text, differences between the stimulus variants can be identified. As the stimuli with a higher-quality article are longer, participants spend more time than average on those stimuli than on ones in a lower-quality article. However, for the third section of the text, which is the same in both stimulus variants, it can be seen that participants viewing a high-quality article fixate on it for longer on average (M = 46.95; SD = 14.88) than participants who were shown a low-quality article (M = 39.96; SD = 14.08).

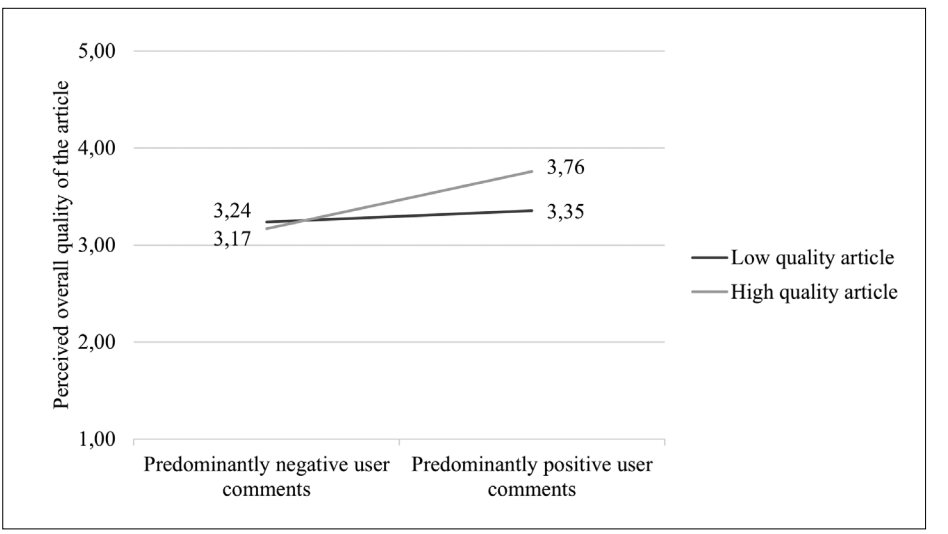
The opposite can be seen in the comment section below the article. Noticeably, the articles with positive comments were read more intensively. This finding is particularly surprising because negative comments (M = 35.13; SD = 20.82) were read much more intensively than positive ones (M = 23.15; SD = 18.62). In addition, the heat maps illustrate that participants paid particular attention to the first comment for all stimulus variants, while less attention was paid to the other comments.

Hypothesis 1 postulates that readers pay more attention to negative comments than to positive ones. A two-sample t-test was performed to test this and to compare users' attention on negative and positive comments. The results revealed a statistically significant mean difference (t(142.97) = 3.657; p < .001). On average, readers looking at negative comments fixate on them for longer (M = 35.13; SD = 20.82) than users looking at positive comments (M = 23.15; SD = 18.62). Therefore, the proposed hypothesis can be supported.

According to Dohle (2018) and Urban and Schweiger (2014), the article's journalistic quality is measured with seven quality dimensions. Regarding the effect of the comments on these individual quality dimensions, we assume that positive reader comments affect the perception of the quality dimensions in a positive way (H2).

To test this hypothesis, a two-way analysis of variance was conducted, including the quality of the article (high vs. low) and the comments (positive vs. negative) to analyze interaction effects. Figure 3 and Table 2 show the differences in the participants' ratings.

Figure 3. Interactive influence of the article's quality and the user comments on the evaluation of the article's perceived overall quality.



Note. 1 = low quality, 5 = high quality; n = 143 (cases used, excluding missing values; N = 145).

The participants rated the high-quality article with positive comments as having the best quality on average (M = 3.76; SD = 0.75). In the other three groups, the quality of the respective article was rated lower on average. These differences are statistically significant (p = .15). At the same time, the overall quality of the high-quality article version (M = 3.43; SD = 0.90) is only slightly better evaluated than the low-quality version (M = 3.29; SD = 0.85). The individual analysis of the seven quality dimensions also shows that the high-quality article with positive comments was rated best in almost all subdimensions except relevance and impartiality. However, the subdimensions in these four groups show no statistically significant mean differences.

Table 2. Participants' perception of the article's journalistic quality according to the four stimulus variants

Quality dimension	High article quality/ negative comments *M* (*SD*)	High article quality/ positive comments *M* (*SD*)	Low article quality/ negative comments *M* (*SD*)	Low article quality/ positive comments *M* (*SD*)	*F*	*p*
Overall quality	3.17 (0.94)	3.76 (0.75)	3.24 (0.92)	3.35 (0.77)	3.33	.02
Relevance	3.43 (0.91)	3.64 (1.08)	3.68 (1.12)	3.42 (1.05)	0.62	.61
Accuracy	3.86 (0.68)	4.06 (0.75)	3.65 (1.04)	3.58 (0.81)	2.38	.07
Comprehensibility	4.10 (1.01)	4.36 (0.78)	4.18 (0.72)	4.06 (0.89)	0.86	.46
Impartiality	2.29 (1.04)	2.52 (1.18)	2.59 (1.44)	2.31 (0.95)	0.62	.61
Ethics	3.69 (1.09)	4.06 (1.12)	3.79 (1.01)	3.64 (1.13)	1.03	.38
Transparency	3.12 (0.97)	3.58 (0.97)	3.12 (1.12)	3.47 (0.81)	2.15	.10
Diversity	2.55 (0.83)	2.82 (0.92)	2.44 (0.96)	2.69 (0.89)	1.16	.33

Note. Results of analysis of variance: 1 = low quality to 5 = high quality; M = mean, SD = standard deviation; N = 145 ("Overall quality" with n = 143 due to missing values).

Comparing the user comments condition, the article's overall quality was evaluated better for the high-quality article version. The low-quality article was also evaluated as slightly better under the negative comments condition. There was no statistically significant interaction effect for the overall quality ($F(1, 139) = 2.709$, $p = 0.10$; $\eta_p^2 = .02$) or for any of the specific quality dimensions. However, the influence of the article's quality on the evaluation of its accuracy was statistically significant ($F(1, 141) = 6.265$, $p < .05$; $\eta_p^2 = .04$), as was the influence of the user comments on the perceived transparency ($F(1, 141) = 6.271$, $p < .05$; $\eta_p^2 = .04$).

6. Discussion and conclusion

User comments have been a well-established part of news websites as an audience feedback mechanism for over 20 years. Therefore, they will continue to influence readers' perception of news articles. This study examined the influence of user comments on the perception of journalistic quality from the audience's perspective using eye-tracking measurement technology and survey data. In this respect, (1) the participants' level of visual attention and (2) different journalistic quality dimensions were measured.

Building on previous research about the perception of journalistic quality and the influence of user comments, the valence of such comments (negative vs. positive) and several different normative news quality criteria were explored through an online survey and an eye-tracking experiment with 145 participants in Germany.

This perspective warrants special attention, as user comments and comment sections remain a double-edged sword. On the one hand, they are spaces for participatory discourse among the audience and with media outlets. On the other hand, the ever-blurrier boundaries between constructive criticism and "dark participation patterns" (Frischlich et al., 2019) pose new challenges to media organizations in the context of spillover effects on the perception of news quality.

The RQ dealt with the fixation duration on the articles. The results show that a high-quality article was fixated on for longer on average than a low-quality article. Further, articles with positive comments below them were read more intensively.

The findings indicate that high-quality articles are more likely to captivate readers' interest and maintain their attention throughout the reading process compared to low-quality ones. Articles with accurate information, a clear structure, and compelling narrative are inherently more engaging and may encourage readers to spend more time absorbing the content (Gladney et al., 2007). At the same time, a deeper processing and cognitive effort from readers might be required. In contrast, low-quality articles may fail to capture readers' interest due to poor writing, factual inaccuracies, or lack of coherence, which lead to quicker processing and shorter fixation durations as readers quickly lose interest and disengage.

Regarding the influence of positive comments on reader engagement, positive comments may create a favorable context for the article, enhancing readers' expectations and predisposing them to perceive the content more positively. This positivity bias might lead readers to approach the article with a more open mind, increasing their motivation to engage with the content and prolonging their reading time. Further, participants returned to the article after reading the positive comments, thus spending longer reading the article, with a spotted gaze path pattern showing where they specifically scanned for visual cues such as subheadings (see Pernice, 2019). Additionally, positive comments may serve as social validation, reinforcing the perceived value of the article and prompting readers to invest more attention and effort into understanding its content.

Regarding the first hypothesis, the results also indicated that readers paid more attention to negative comments than to positive ones, which aligns with previous research by Kohout et al. (2023). According to Bachleda et al. (2020), Rozin and Royzman (2001), and Unkelbach et al. (2020), there is also a negativity bias in

human perception of information, which means that they have a more substantial effect on human perception, memory, decision-making, and behavior than neutral or positive information. Therefore, negative content is more likely to be perceived as valid than positive news (Hilbig, 2009). Overall, the findings show that comments grab attention, and negativity in particular addresses the individual's need for orientation and thus acts as an orientation aid for recipients (Kümpel & Unkel, 2020).

The results further indicate that recipients' perception of the article's quality was in line with the manipulation of accuracy, comprehensibility, ethics, transparency, and diversity (Dohle, 2018; Urban & Schweiger, 2014). The participants rated the high-quality version of the article more highly than the alternative version, yet the differences are small. A possible explanation could be that while news consumers recognize differences in journalistic quality in general, and the accuracy of news articles in particular, they are less likely to identify differences between news articles that differ in their adherence to other quality criteria (Urban & Schweiger, 2014).

Regarding the second hypothesis, it was confirmed that positive reader comments affected participants' perception of specific quality dimensions. However, there is only a statistically significant effect of user comments on the perceived transparency of the article.

The explanations are manifold: Readers may experience cognitive dissonance (Festinger, 1957) when faced with information that contradicts their beliefs or attitudes, like the usefulness of a speed limit. As most participants (81.4%; n = 118) stated that they sometimes go over the speed limit, although it is socially desirable not to do so (Bailey & Wundersitz, 2019), positive user comments may help reduce cognitive dissonance by providing reassurance or validation of one's choices or beliefs, making readers more accepting of the article's merits. At the same time, "[c]ognitive dissonance will only play a role in the process of information selection if the topic is of some relevance to the individual" (Donsbach, 1991, p. 157). Readers recognize the presence of argument diversity, which also increases overall news satisfaction (Zerback & Schneiders, 2024).

Positive comments may also reinforce readers' preexisting expectations. Given that the article's topic and layout are similar to those of the quality news magazine *Der Spiegel*, the participants might subconsciously expect such a journalistic article to be of good quality. When they encounter positive comments about an article, especially if those comments align with their expectations, they might be more inclined to see the article as transparent or diverse.

Overall, the findings show that participants spend longer reading the high-quality article sections than the low-quality article ones, but this did not lead to vastly different quality perceptions. A reason might be that the measurement of quality perception relates to observable quality criteria (e.g., offering correct and precise information is indicative of accuracy) (Dohle, 2018; Urban & Schweiger, 2014). If participants only have vague conceptual knowledge about these criteria, they "might be unable to retrieve the relevant information from memory, which would hinder them from accurately assessing whether it complied with the respective journalistic standard" (Weber et al., 2019, p. 25). Moreover, as the user comments

in both article versions offered only slightly contrasting viewpoints and did not use particularly positive or negative wording, it can be assumed that this is the reason for the statistically small effects.

As a result, the process of news quality perception requires a nuanced understanding against the background of how readers actually pay attention to user comments accompanying an article in order to make informed statements about their influence. It can also be stated that comments matter for quality perception but not necessarily more than the actual quality of the article. The reason is that both comments and the perceived journalistic quality depend "on external factors, such as user variables (e.g., informational needs, behavioral intentions, and involvement) as well as the context variables" (Haim et al., 2018, p. 204).

As is always the case, this study is subject to some limitations. First, most participants are young, highly educated digital natives. Thus, they might have a more nuanced perspective around the perception of journalistic quality. Second, the findings rely on self-reported perceptions of journalistic quality. The accuracy of such self-reported measures can be influenced by various motivational or cognitive processes related to individual characteristics. Third, eye tracking does not provide insights into the intention or motivation for the participants to view certain visual stimulus areas or emotional or cognitive processes while they are receiving them.

Fourth, although a news brand was not mentioned, the layout was based on *Der Spiegel*'s website. On the one hand, this approach provides an opportunity to investigate perception from a particular real-life perspective; on the other, the participants may have recognized the layout anyway and the reputation of the familiar news brand could have implicitly influenced their perception of the article's journalistic quality. Fifth, since the manipulated news article was based on a news story from a high-quality German news magazine and the experiment followed Dohle's approach (2018), a pretest of the material was not considered imperative. In addition, familiarity with the issue was presumed, as the speed limit on Germany's autobahn network regularly comes up in public discourse (Puls & Wendt, 2021).

Future research could investigate factors such as the level of civility, relevance of the article, coherence, and overall sentiment expressed in user comments. Research could examine whether diverse perspectives within user comments influence the perception of journalistic quality. Another possibility might be to explore how the prominence of user comments within the article interface (e.g., placement, visibility) affects readers' attention allocation and interpretations of journalistic quality.

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FULL PAPER

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Maria F. Grub

Maria F. Grub (M. A.), Friedrich-Schiller-University Jena, Institut für Kommunikationswissenschaft, Ernst-Abbe-Platz 8, 07743 Jena, Germany. Contact: maria.grub@uni-jena.de. ORCID: https://orcid.org/0009-0004-3676-1984

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Abstract: Using data of *N* = 70 articles from newspapers in the United Kingdom, this study explores whether UK print media of both broadsheet and tabloid press make use of issue-specific frames (Entman, 1993) in the reporting on male rape. Current UK legislation does not recognize women as perpetrators of male rape; this was also reflected in the majority of articles addressing male rape. A total of nine frames were identified following Mayring's (2015) approach to qualitative content analysis. The frames can be differentiated into situational, victim, and perpetrator frames. The reporting includes (male) rape myths based on sex stereotypes placing perpetrators and victims in unequal power dynamics. In line with previous research, the findings can be related to sex-role socialization, which places men and women into stereotypical categories of masculinity and femininity. In addition, sex-role socialization is expanded by matters of sexual orientation: Stereotypes of femininity are projected on homosexual men and the victims are placed in a subordinate role compared to the perpetrators. The comparison of tabloid and broadsheet press shows that both portray male rape similarly. However, tabloids put greater emphasis on entertainment and use ways that are more in touch with the audience to illustrate male rape.

Keywords: Male rape, rape myths, rape frames, framing, print media, socialization

Zusammenfassung: Diese Studie untersucht anhand von *N* = 70 Zeitungsartikeln, ob britische Printmedien der Qualitäts- und Boulevardpresse themenspezifische Frames (Entman, 1993) über die Vergewaltigung männlich gelesener Personen verwenden. Die derzeitige britische Gesetzgebung erkennt Frauen nicht als Täterinnen von Vergewaltigungen an Männern an; dies wurde auch in der Mehrzahl der untersuchten Artikel widergespiegelt. Insgesamt wurden neun Frames anhand von Mayrings (2015) Ansatz zur qualitativen Inhaltsanalyse ermittelt. Die Frames können in Situations-, Opfer- und Täter-Frames unterschieden werden. Die Berichterstattung umfasst (männliche) Vergewaltigungsmythen, die auf Geschlechterstereotypen beruhen und Täter und Opfer in ungleichen Machtdynamiken darstellen. In Übereinstimmung mit früheren Untersuchungen können die Ergebnisse mit der Geschlechtsrollensozialisation in Verbindung gebracht werden, die Männer und Frauen in stereotype Kategorien von Männlichkeit und Weiblichkeit einteilt. Darüber hinaus wird die Geschlechterrollensozialisation durch Fragen der sexuellen Orientierung erweitert: Stereotypen von Weiblichkeit werden auf homosexuelle Männer projiziert und die Opfer werden im Vergleich zu Tätern in eine untergeordnete Rolle gedrängt. Der Vergleich von Boulevard- und Qualitätspresse zeigt, dass beide die Vergewaltigung von Männern im Zusammenhang mit ähnlichen

Themen darstellen. Die Boulevardzeitungen legen jedoch mehr Wert auf Unterhaltung und verwenden publikumsnähere Mittel, um die Vergewaltigung von Männern darzustellen.

Schlüsselwörter: Männliche Vergewaltigung, Vergewaltigungsmythen, Printmedien, Sozialisation

1. Introduction

"Women were more likely than men to be victims of sexual assault in the last year.", reads a headline in the Office for National Statistics (ONS) report on sexual offenses in England and Wales (Office for National Statistics, 2022). A bar graph (see Appendix A in OSF) summarizes the numbers of female and male victims by type of abuse, i.e., any sexual assault, rape, or assault by penetration and indecent exposure or unwanted sexual touching. However, when looking at the graph, one bar seems to be missing: Male victims of "rape or assault by penetration."[1] According to the National Sexual Violence Resource Center: "81% of women and 43% of men reported experiencing some form of sexual harassment and/or assault in their lifetime." (2023). The statistics show that men are also being raped. However, the UK, a country with the highest number of recorded rape cases in Europe (Beswick, 2017), theoretically did not get its numbers wrong, and yet, men were raped.

Defining rape has challenged researchers and lawmakers for centuries now. Rape describes "the physical and sexual use of another person's body without that person's consent." (Baker, 1999, p. 233) and is, therefore, a human rights violation that stands in contrast with sexual autonomy and sexual sovereignty (Horvath & Brown, 2013, p. 3). Any occurrence where a victim does not want to engage in sex but is coerced or forced to do so, or is unable to (dis)agree, is to be classified as rape (Williams, 2015, pp. 428–429).

In feminist writing, rape is a gendered term that fosters patriarchal power structures in Western society (Brownmiller, 1975, p. 343). Feminists argue that it does not matter *where* a victim gets raped, *what* a victim's relationship to the perpetrator is, or *when* the incident happened because "A rape is a rape is a rape." (Bonnes, 2013, p. 211). But this raises the question: Why does it matter *who* the victim is?

The legal framework of the UK accepts this gendered definition of rape. It did not acknowledge male rape until the *Criminal Justice and Public Order Act* in 1994 (Cohen, 2014, p. 24). From then on, it was "an offence for a man to rape a woman or another man." (Criminal Justice and Public Order Act, 1994, p. 142). Since the *Sexual Offences Act* (2003), rape is defined as forced vaginal, anal, or oral penetration (p. 1). Although men are now recognized as potential victims, women are not legally recognized as perpetrators. This likely explains the absence of male rape cases in the previously mentioned ONS report. While male rape accounts for a smaller portion of cases, the estimated number of both male and female victims is

1 The ONS report does not include non-binary people in its statistical reporting. When this manuscript refers to "male" and "female" (or "man/ men" and "woman/ women"), it refers to the person's born sex as reported by the UK media/ government. Henceforth, the article will use the term "sex" to distinguish between men and women, and will omit the term "gender". The author would like to point out that they do not support a binary gender classification. The exclusion of non-binary and trans people from analysis is only due to the lack of data material in the UK data.

much higher, including male victims of female perpetrators (Williams, 2015, p. 429). As though women are more likely to become victims of sexual assault, men report similar circumstances (Banyard, 2007). Findings from a survey by Choudhary and colleagues (2010) support this:

Table 1. Relationship with perpetrator and gender of the perpetrator (past 12 month vicitmization only)

	Gender of Perpetrator by Category of Victimization					
	AI		CI		ACI	
	Wtd % (n = 633)		Wtd % (n = 127)		Wtd % (n = 187)	
Relationship With Perpetrator	Male Perpetrator	Female Perpetrator	Male Perpetrator	Female Perpetrator	Male Perpetrator	Female Perpetrator
Current intimate partner[a,b]	0.87	11.99	1.49	13.26	6.93	21.55
Former intimate partner[a,c]	3.05	18.06	0.00	23.98	0.00	8.96
Friend/acquaintance/coworker	51.46	59.82	40.49	55.32	28.61	53.47
Parent/stepparent[c]	5.27	0.40	23.15	1.60	44.98	5.29
Stranger/other[d]	39.35	9.74	34.87	5.84	19.48	10.72

Note: Wtd = weighted; AI = attempted intercourse; CI = completed intercourse; ACI = attempted and completed intercourse. Response included only those
who experienced sexual violence in the past 12 months
a. Responses include spouse, girlfriend, or boyfriend.
b. Differences between male and female perpetrators are statistically significant in "AI" victimization category: $p < .001$.
c. Differences between male and female perpetrators are statistically significant in all three categories of victimization: $p < .05$.
d. Differences between male and female perpetrators are statistically significant in "AI" and "CI" victimization categories: $p < .05$.

The data outlines the relationships between victims and perpetrators of sexual violence, namely current intimate partner, former intimate partner, friend/ acquaintance/ coworker, parent/ stepparent, and stranger/ other. Furthermore, the data is broken down by gender of the perpetrator (male or female) and the instance of victimization: Attempted Intercourse (AI), Completed Intercourse (CI), and Attempted and Completed Intercourse (ACI). It shows that perpetrators are predominantly male across all categories, though significant female perpetration is also reported. Friends, acquaintances, and coworkers are the most common relationship type for both male (AI = 51.46%; CI = 40.49%; ACI = 53.47%) and female (AI = 59.82%; CI = 55.32%; ACI = 28.61%) perpetrators. Furthermore, regarding the categories "parents/ stepparents" and "strangers/ other", the percentage of male perpetrators is much higher than female perpetrators (e.g., $ACI_{parents/stepparents}$ = 44.98% for male perpetrators compared to $ACI_{parents/stepparents}$ = 5.29% for female perpetrators) (Choudhary et al., 2010, p. 1535). This differentiation into acquaintance rape, including date or spousal rape, and stranger rape is a common way to distinguish rape situations (e.g., Bevacqua, 2000, p. 154; Serisier, 2018, p. 57). However, as discussed in the results, sexual violence is often committed by individuals known to each other, particularly friends or acquaintances, regardless of perpetrator gender, and the idea that stranger rape is more prominent is a common misconception (Choudhary et al., 2010).

Misconceptions about rape are deeply rooted in our society. Social constructions – such as gender, race or religion – are foundational to systems of oppression and power (Brubaker, 2021, p. 724). The patriarchal system emphasizes power, domi-

nance, and control, often perpetuating violence to maintain hierarchy (Kaplan, 2024, p. 6). Within such systems, rape serves as a tool of domination, which occurs on many levels (e.g., rape as part of warfare (Wood, 2018) or the music industry (McCarry et al., 2023)). This applies not only to women as victims but to men as well. Male rape can thus occur as an assertion of dominance, emasculating the victim and stripping them of agency within a patriarchal framework that equates masculinity with power and invulnerability (Reed et al., 2020, p. 163). Through early socialization processes, men and women are placed into categories according to their born sex, leading to stereotypes and myths about what is considered "male" and "female" (Fadnis, 2018, p. 1753).

As print media still represents one of the main news sources in the UK (Ofcom, 2023, p. 3), it will be the subject of this article and henceforth be used interchangeably with "the media". The way that a rape situation, victims, and perpetrators are framed in the media affects the public's perception of rape and the acceptance of rape myths (Barnett, 2012, p. 18). Moreover, through media effects, reporting may reinforce stereotypes and shape the recipients' perceptions (Genner & Süss, 2017, p. 1). Furthermore, it is important to consider whether stereotypes about rape (including rape myths) are represented in the press, as the media's portrayal of rape fosters these stereotypes and shapes society's view of rape (Hust et al., 2023, p. 477). This will hopefully lead to a better understanding of the UK's perception of male rape and offer suggestions for the press in dealing with rape cases. Therefore, this study will examine *how male rape is framed in the UK broadsheet and tabloid press, and to what extent the framing of male rape conveys stereotypes and rape myths based on sex-role socialization in the United Kingdom.*

Research on male rape has primarily only examined male-on-male incidents, particularly childhood victimization (Fromuth & Burkhart, 1989; Miller & Lisak, 2002), or rape in prison (Mulholland & Manohar, 2023; Scacco, 1982). This paper will therefore expand on current research by including cases of female perpetrators and male victimization outside of an institutionalized setting. The analysis is based on a combination of Entman's (1993) framing approach and Mayring's (2015) approach to qualitative content analysis to deduce media frames. The aim is to determine how the media reflects sex-role socialization and myths about male rape. The results will be discussed within the cultural background of the UK, and whether rape as solely a feminist issue must be reconsidered.

2. Review of the literature[2]

2.1 Sex role socialization and rape myths

According to sex-role theory, men and women are attributed with characteristics based on their biological sex, placing them into stereotypes of being "male" and "female", deciding the roles men and women occupy in society (Eagly et al., 2016,

2 The literature review will focus on empirical evidence from Western countries, which are assumed to share a similar cultural and socialized background to the UK (i.e., USA, Canada, Australia, Germany, and Sweden), and define the research objectives similarly (e.g., sex roles, rape myths).

p. 459). Stereotypes are common beliefs about specific social groups that link potentially false associations to their behavior (Jecker, 2014, p. 184). This shapes cultural beliefs about sex-role stereotypes (Grubb & Turner, 2012, p. 446) and our attitudes towards and acceptance of these roles (Borisoff & Chesebro, 2011, p. 30).

In most Western (primarily Anglo-American) societies, male role expectations are defined through a set of certain physical, emotional, and behavioral characteristics (Eagly et al., 2016) such as physical strength (Reed et al., 2020, p. 163), body shape and size (Borisoff & Chesebro, 2011, p. 32), heterosexuality (p. 33) and lustfulness (p. 35). Furthermore, maleness is linked to (sexually) aggressive behavior (Cohen, 2014, p. 14), dominance (Reed et al., 2020, p. 163), and a lack of emotionality (Lisak, 2006, p. 320). Female features, in contrast, include "vulnerability, submissiveness, and emotionality" (Reed et al., 2020, p. 163), softness, and a lack of self-efficacy (Borisoff & Chesebro, 2011, p. 31). Men who exhibit feminine features are perceived as non-male, breaking traditional sex norms (Lisak & Ivan, 1995, p. 296).

Rape myths emerge from such sex-based stereotypes (Zenovich & Cooks, 2018, p. 405). They are understood as "prejudicial, stereotyped and false beliefs about rape, rape victims and rapists" (Burt, 1980, p. 217). Long-established rape myths mainly apply to female victims, but most of them can also be applied to cases of male rape (Anderson, 1999, p. 389). Reed et al. (2020) detected in an online survey of US college students that rape myths influence the perception of victims and perpetrators and that rape myths such as "men cannot be raped" and "real men can defend themselves against rape" were commonly accepted (p. 162).

Rape myths can be categorized into three types: Victim myths, perpetrator myths, and myths about the rape situation (Li et al., 2017, p. 775). Examples of common rape myths include that victims encourage rape through dressing provocatively (Raphael, 2013, p. 61) or that a victim is more to blame if they know the perpetrator (Bieneck & Krahé, 2010, p. 1793). A list of common rape myths derived from the literature can be found in OSF online Appendix B (https://osf.io/59umr/?view_only=f88e9204ca1c4a038c41d9a9de5d6722).

Research shows that rape myths are not only prevalent in society but are often even internalized by victims of rape. For example, rape victims are faced with difficulties in recognizing the crime and struggle to come forward as they often feel ashamed (Banyard, 2007, p. 63) or question their sexuality (Gartner, 2018, p. 9). Multiple studies conducted in the USA show that especially heterosexual men feel embarrassed about reporting their victimization (Donnelly & Kenyon, 1996, p. 445; Gartner, 2018, p. 9). This aligns with findings by Choudary et al. (2010) that gay and bisexual men were more likely to report rape than heterosexual men (p. 1525).

Building on this, Wakelin and Long (2003) discovered differences in the attribution of blame regarding sex and sexual orientation in a study with UK participants: Female victims who identified as heterosexual were blamed more than male heterosexual victims, and in general, more blame was attributed to the victims than the perpetrators (Wakelin & Long, 2003, p. 484). Davies et al. (2006) expanded these findings and discovered that male British participants were more negative towards

male victims if the perpetrator was female, and the male victim identified as heterosexual (p. 286).

2.2 Framing rape in print media

According to Entman (1993), "to frame is to select some aspects of a perceived reality and make them more salient in a communicating text" (p. 52). Frames can significantly alter how an audience perceives even controversial issues (Lecheler & de Vreese, 2019, p. 1), often without realizing that a specific frame has been employed (Tankard, 2003, p. 97). The media in this way co-constructs and co-constitutes socialization and how individuals are "receptive to specific stereotypes portrayed in media" (Genner & Süss, 2017, p. 2).

Multiple studies have identified issue-specific frames – frames that only apply to specific issues (Jecker, 2014, p. 43) and address content-related aspects of these issues (Matthes, 2014, p. 60) – in media reporting about rape (e.g., Hindes & Fileborn, 2020; Nilsson, 2019). The reporting often incorporates rape myths (Nilsson, 2019; Northcutt Bohmert et al., 2019) and reflects patriarchal power structures (Hindes & Fileborn, 2020, p. 643). This is especially evident in the reinforcement of sex roles and stereotypical display of what constitutes "male" and "female" (Harway & Steele, 2015, p. 376). A study on masculinity and femininity in the British national press revealed that reporting favored references to masculinity and, linking it to power and strength (Baker & Baker, 2019, p. 380). The coverage of rape is often embedded in cases that involve celebrities and makes use of overdramatization and sensationalism (Barnett, 2012, p. 15). Further detected framing devices include what the Canadian researcher Susan Ehrlich (2001) named a "language of assault" (p. 26). This includes, for example, sexist vocabulary, emotive language, and victim-blaming language (Northcutt Bohmert et al., 2019, p. 885). Victim blaming is evoked through a focus on victim details during the rape situation, e.g., level of intoxication (Barnett, 2012, p. 20) or physical attractiveness (Anderson et al., 2001, p. 446). Furthermore, labeling victims and perpetrators, e.g., through applying shared responsibility ("violent couple", Lamb & Keon 1995, p. 211)), a dichotomy of "bad girl – good guy" (Barnett, 2012, p. 19), or othering the perpetrator as "monster" (VanSlette & Hinsley, 2017, p. 7), adds to biased perceptions of rape, shifting the degree of agency, i.e. the person in control of the situation, from the perpetrator to the victim (Ehrlich, 2001, p. 39). Rape situations are trivialized through terms such as "fondling" or "having sex" (Kitzinger, 2013, p. 83) or avoiding the use of "rape" altogether (Bohner et al., 2009, p. 527).

This was shown to influence audiences, leading to increased victim-blaming and acceptance of rape myths (Li et al., 2017, p. 775), and altering understandings of sexual violence and consent (Hindes & Fileborn, 2020, p. 643). People question the legitimacy of a rape incident as well as the roles of victim and perpetrator (Bonnes, 2013, p. 211).

Research so far has primarily focused on female rape rather than male rape, and the framing devices that were mentioned cannot simply be transferred to male rape. In her book *Male Rape is a Feminist Issue*, Cohen (2014) criticizes the predominantly feminist reading of media reporting of male rape, which assumes that only

the rape of women is a direct consequence of patriarchal societal structures (p. 4). Consequently, male rape is not considered a real phenomenon (p. 93). This manuscript deviates from early feminist research on rape and does not perpetuate a solely sex-based stance on rape; hence, the existing frames on rape in print media must be considered with caution, as male rape frames may deviate from existing literature.

3. Research method

A qualitative content analysis, following Mayring's (2015) inductive, structural approach, was conducted, paired with Entman's (1993) framing approach. Mayring's (2015) approach involves several steps of analysis, which can be broadly summarized as: (1) Establishing the material, (2) the direction of analysis, (3) choosing the type of analysis, (4) interpretation of the results and categorization, and (5) application of quality criteria. A full overview and description of the coding process can be found in Appendix C (see OSF). This also includes an overview of the applied quality criteria to ensure validity and reliability (Krippendorff, 1980).

The sample was drawn by a keyword search of *"male rape," "male rape victim," and "female perpetrator"* from UK newspaper articles[3] published from 1990 to 2024 available on the LexisNexis database (N = 1,413). This period was chosen in light of the Criminal Justice and Public Order Act of 1994, as well as the preceding years from 1990, in case there were any reports leading up to the new law. Articles with fewer than 100 words and articles covering only female victims of rape, childhood abuse, reports from outside the UK, as well as personal statements of survivors, were excluded in the first screening of the data. This left a total of 412 articles. All articles were then sorted into broadsheet (n = 144) and tabloid (n = 268) articles and labeled according to their main topic to gain an initial overview. A full overview of the articles can be found in Appendix D (https://osf.io/59umr/?view_only=f88e9204ca1c4a038c41d9a9de5d6722).

The analysis was conducted using a qualitative content analysis following Mayring's (2015) approach of structural analysis. The method was chosen as qualitative analysis aims to detect patterns and meanings embedded within a text, "to identify cultural themes and meanings associated with a particular set of texts and in a particular space and time." (Gutsche & Salkin, 2015, p. 15). Through the inductive approach, these patterns can be detected directly from the material, offering deeper insights into the topic, while also following a systematic approach (Mayring, 2015). In line with Mayring's (2015) approach, the analysis followed an inductive, iterative process (see Appendix C in OSF). In the initial assessment of the material, frame elements were identified. In the course of the analysis, patterns emerged, including references to outside sources, dramatizations, narratives, and contextual patterns. By applying the dimensions based on prior research (e.g., rape myths,

3 The following newspaper outlets were included for Broadsheet press: *The Times* (including *The Sunday Times*), *The Guardian*, *The Herald*, *The Belfast Telegraph*; and tabloid press: *The Independent*, *The Sun*, *The Daily Mail* (including *The Mail on Sunday*), *The Mirror*, *The Manchester Evening News*, and *The Scotsman*.

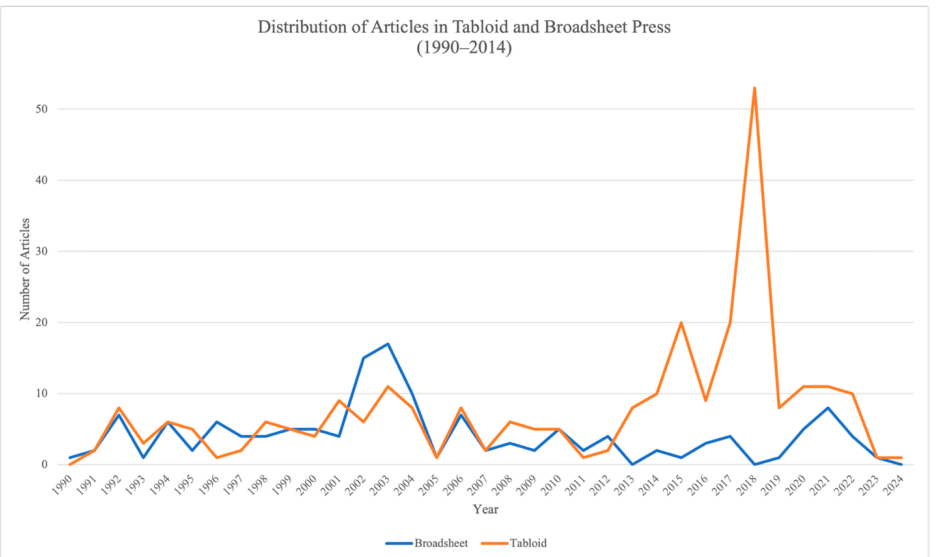
lexical findings, agency, and detail-inclusion), it was possible to generate a first set of categories and characteristics. In total, the analysis consisted of five repeating cycles until no further categories were derived and saturation was achieved. The categories were placed into "typical" characteristics, allowing the construction of prototypes. These prototypes are the frames that will be described in detail in the following sections.

In the process of qualitative analysis, the sample size was not predetermined; instead, the material was coded until theoretical saturation was reached. The final sample was drawn using a random number generator, alternating between tabloid and broadsheet press. Ultimately, 35 articles each were coded in the main analysis (N = 70). During the screening, nine articles explicitly addressing female perpetrators of male rape were identified and analyzed in an additional, explorative analysis step.

4. Descriptive findings

In the last 34 years, a total of 412 articles published in the UK press addressed male rape. Tabloids address the topic more frequently (n = 268) than broadsheets (n = 144). Regarding the timely distribution of publications, male rape is evenly presented in the print reporting, with a spike for broadsheet articles between 2002 and 2004 and an all-time high for tabloid articles in 2018. The overall distribution is illustrated in Figure 1.

Figure 1. Distribution of articles in tabloid and broadsheet press (1990–2024)

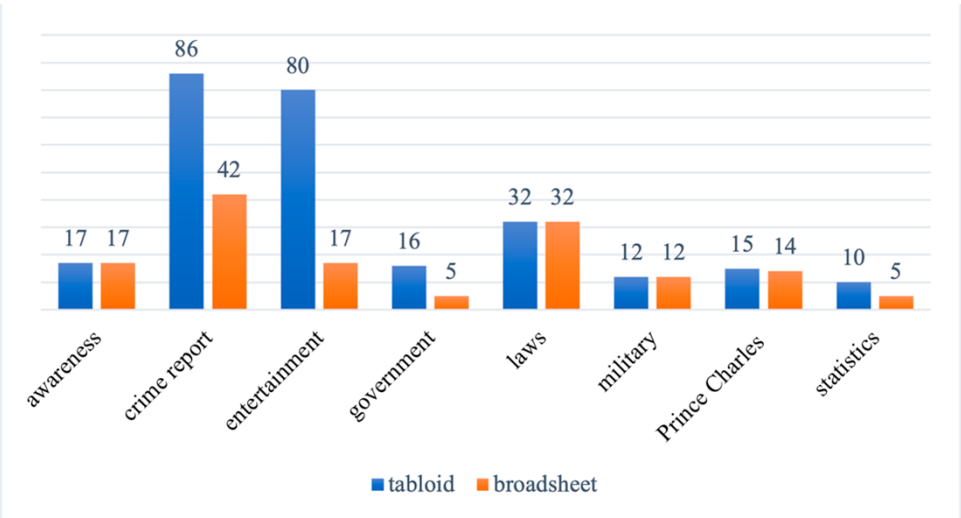


The outliers can be explained by the primary topics that the articles address. The reporting in broadsheets addressed the issue of a male rape case involving the staff of Prince Charles in 2002–2003. Articles in 2004 deal with a prominent rape case

in the British armed forces. The spike in tabloids is due to an episode of the popular soap opera Coronation Street, which aired in 2018 and included a storyline about a male rape case.

Examining the overall topic distribution, crime reports account for most of the reporting about male rape. Crime reports comprise all such articles that address reported incidents of male rape. This includes police reports, detailed portrayals of rape incidents, as well as reports about victims and perpetrators. Other topics, such as law issues and spreading awareness (e.g., reports about charities) are equally present in tabloids and broadsheets. A comprehensive overview of the topic distribution is presented in Figure 2.

Figure 2. Topics by broadsheets and tabloids



The framing analysis revealed situational, victim, and perpetrator frames, each with respective sub-frames. The frames will be regarded in detail in this section:

4.1 Situational frames

4.1.1 "Male rape = gay rape" frame

In both the broadsheet and tabloid press, male rape is portrayed as an issue that occurs solely within the homosexual community. There is, however, some differentiation between homosexual and heterosexual victims as well as perpetrators. The articles refer to a "gay rape culture" (T10) and "gay-bashing" (T3). *Gay rape culture* means male rape is seen as happening only among members of the gay community. It is seen as equivalent to female rape incidents. Gay rape victims are viewed as victims of male dominance and are placed in a subordinate position, for example: "Young gay men will likely make the most silent, compliant victims." (T10). Some tabloid articles describe the issue as more pressing than female rape,

presenting it as an often undetected and neglected crime. The analysis revealed differences in victimisation: Homosexual victims, especially those targeted by heterosexual perpetrators, are presented as more vulnerable because of their sexuality. The media also points out that heterosexual victims are often faced with the rape myth of being perceived as gay for becoming victims and having their sexuality questioned. In cases involving heterosexual perpetrators, the crime is related to male dominance over another man through so-called *gay-bashing*. This refers to the act of humiliating another person for being gay, for example: "There is a clear group of men who, although they lead a heterosexual life outside, regard themselves as very macho and see the aggressive act of penetrating another person as something manly." (T3)

Most articles avoid using the word "rape" and use "sex act" (B4) instead. Articles that include the word mainly refer to it as "gay rape" or "homosexual rape", even more so in the broadsheet press. Male rape is trivialized as "non-consensual homosexual activity" (B5), implying no clear distinction between male rape and "gay sex". This is further reinforced by describing rape as "anal encounters" (B3). Descriptions of male rape in the context of anal penetration are often accompanied by judgmental evaluations (e.g., "deeply unattractive", B4).

Overall, male rape is predominantly referred to as an act within the gay community, often not even acknowledging it as a crime, with female perpetrators excluded from the definition. Common rape myths of male rape are supported by the analyzed media. Through lexical choices like using gay rape interchangeably with male rape, the crime is limited to a specific situation and actors. Broadsheet press makes more use of this frame than tabloids.

4.1.2 "Culture of silence" frame

Although male rape is identified as a crime and occasionally described as "very serious" (B10), the article addresses a so-called "Culture of Silence" around rape. By including current studies, statistics, or references to researchers and law enforcement in the articles, male rape becomes more transparent, and the tone is serious. However, there is a "blanket of silence surrounding male rape." (B8). The topic is viewed as a "sensitive subject" (T2) without significant awareness. This is linked to a lack of knowledge, as one article puts it: "[W]e know nothing about the perpetrators of rape on men and only something about the perpetrators of rape on women." (B1). The analysis revealed that articles try to emphasize the urgency of the topic and tackle the myth that men cannot be victims of rape. This awareness only regards male-on-male rape. The voices of rape survivors are only present in the context of charities like Survivors Manchester. Otherwise, male rape victims remain passive in the reporting and are hence silenced by the media themselves.

The "Culture of silence" frame is present in both tabloid and broadsheet press. Both undermine the frame with references to statistics and expert voices; however, the tabloid press puts greater emphasis on the influence of the media and addresses the sensitivity of the crime, whereas the broadsheet press emphasizes the problem but does not provide solutions to end the silence.

4.1.3 "Male dominance" frame

Both the broadsheet and tabloid press link male rape to male power, calling it a "crisis in masculinity" (B3). This frame aligns with the myth of male dominance over women and other men, as perpetrators seek to prove their sexuality: "Imagine the power a man feels degrading and humiliating a woman or a child, and think how much more power they would feel doing it to a man." (T3). The "Male dominance" frame applies to both perpetrators and victims, as broadsheets note victims' reluctance to report, linking this hesitation to male stereotypes. Broadsheets also stress victims' physical size and strength, portraying them as unlikely victims (B33).

Male rape is linked to male dominance in both the broadsheet and tabloid press. There are differences between perpetrators and victims. While tabloids emphasize the power frame only regarding perpetrators and their intent to prove their maleness by raping other men, broadsheets also apply male dominance to male rape victims who feel reluctant to come forward due to male stereotyping. Therefore, with the "Male dominance" frame, UK print media, on the one hand, supports the common rape myth that rape is a crime conducted by men only; however, it also tries to tackle the myth by addressing male stereotypes.

4.1.4 "Violent attack" frame

Most articles presume that male rape is always violent, overlooking the use of other forms of coercion, such as emotional or psychological manipulation. This aligns with the common rape myth that rape only qualifies as rape if there is evidence of physical force. The articles emphasize that rape is a "violent attack"; e.g., in most articles, "rape" is used interchangeably with "attack", or the mention of rape does not occur at all. The analysis revealed that emotive adjectives are added to emphasize the violence of the attack. This includes, for example, "brutal" (B9), "nasty" (T1), "vile" (T15), or "savage" (T34).

This trivializes male rape by failing to acknowledge non-violent strategies used by rapists, such as coercion or psychological abuse, and making it more challenging for male victims to be taken seriously. Furthermore, the tabloid press makes more use of emotive wording, evoking a sense of dramatization, and its style resembles fictional writing.

4.1.5 "Broader political narrative" frame

Reporting on male rape is often embedded within a broader political narrative. This relates to structural problems in the UK, particularly the laws regarding rape (B32), as well as the overwhelming demand for police officers to address the issue. For example, articles describe how the police were unprepared to handle the crime due to a lack of trained officers (B35). This frame is often paired with other framing devices.

This political narrative seamlessly connects to broader debates about the origin of perpetrators, further shifting conversations toward immigration laws. For instance, an article discussing a perpetrator seeking asylum in the UK suggests that

authorities should "boot him out of the country", stating he "must be deported." (T28). Such sensationalism is particularly evident in reports on large-scale rape cases, including those involving football coach Barry Bennell, soldier Leslie Skinner, or Reynhard Sinaga, who likely raped more than 200 men and filmed his offenses, making it the "biggest rape case in British legal history." (T32)

A specific narrative was constructed around a scandal involving the Royal Family. In 2002–2003, articles covering rape allegations among the staff of Prince Charles prompted extensive reporting in both tabloids and broadsheets. The tabloid press made extensive use of sensationalist reporting. The events were woven into a narrative surrounding Prince Charles and Princess Diana. The focus was either on Charles' involvement or Diana's so-called "intrigue" (T12). Emotive phrasing supported the sensationalized coverage, with examples such as "royal fears" or "sensational collapse" (T16). To support the narrative, Palace voices were interviewed and referenced in the articles. However, these references were used to support the so-called "intrigue" rather than addressing the male rape allegations themselves. Broadsheet coverage particularly emphasized the "damage" inflicted upon the royal family (B6). The events were downplayed as "the Burrell episode" (B2), trivializing the rape and emphasizing the episodic damage to Prince Charles' reputation. In both tabloids and broadsheets, the crime was not the sole focus and instead portrayed as secondary. There was little emphasis on the rape itself, and the main story was built around the royal actors. The victim and perpetrator were considered as supporting characters within the royal narrative. In the future, it will be important to examine whether incidents like these evoke issue-specific frames, such as a "Royal Family" frame in news coverage.

4.1.6 "Soap opera" frame

A frame predominantly observed in tabloid press is the "Soap opera" frame. These articles focus on portrayals of male rape in an entertainment context, emphasizing the importance of addressing this topic in the media. It is viewed as a symbol of hope, aiming to break the culture of silence and encourage survivors to come and seek support. This is particularly noticeable in the reporting on the show *Coronation Street,* which aired an episode in 2018 where one of the main characters was raped by a male acquaintance. The coverage praises soaps for portraying "upsetting topics" (T19) and references charities and playwrights to discuss the issue. The importance of the media is emphasized, as these articles suggest that it portrays the real world and therefore serves an educational function for the viewers. For example, "Ryan, who worked closely with the charity Survivors Manchester, said: 'I knew it would be a challenging storyline but a very important storyline.'" (T20)

In contrast to the tabloid press, the broadsheet press only occasionally mentions the portrayal of male rape in soap operas, but does not pay particular attention to the topic compared to the tabloid press. This is especially noticeable in its reporting on the soap opera *Coronation Street,* which is not featured prominently in broadsheet reporting.

4.2 Victim frames

4.2.1 "Vulnerable victim" frame

In both the broadsheet and tabloid press, male victims were stereotypically portrayed as "young vulnerable men" (B30). Victims were described using emotive and judgmental adjectives like "naïve" (B5) or "distressed" (T28). There was particular emphasis on their situation prior to the rape. Oftentimes, victims were portrayed to have been in a troubled emotional state, for example, after a conflict with their partner. This style of reporting shifts blame onto the victims. It portrays them as easier targets to blame. Their already vulnerable state is exacerbated by the rape situation, making them appear helpless. For example: "David will be left feeling shame and disgust over what has happened to him." (T2). The victim's experiences are framed within a dramatic narrative, shifting the focus away from the crime itself and instead attempting to evoke a sympathetic response towards the victim. This emotional approach allows the audience to see the severe consequences on the psychological state of victims; however, it also places victims in a vulnerable, damaged position.

Furthermore, the articles frequently employ passive voice or even agentless passive constructions. This implicitly shifts blame away from the perpetrator, who is either unmentioned or not portrayed as the active agent in the situation. For example: "A man has been raped in a daylight attack in Edinburgh city centre." (B15). Passive voice places the victim in an acting position and partially exonerates the perpetrator. Phrases such as "alleged victim", "the victim claims", or the avoidance of the words "rape" and "rapist" shift blame from perpetrators to victims even further. The term "survivor" is almost exclusively used in the context of charities like Survivors Manchester, or in the rare instances of direct speech, e.g., "Sitting down with Jack and talking through some of my own experiences as a survivor." (T29).

The articles differentiate between male and female victims. While mentioning a lack of support for men, who may feel reluctant to come forward, they offer no guidance for affected individuals. The narrative quickly shifts from male victims to female victims, as female rape remains the more prevalent phenomenon. However, rape myths persist for both groups. Statements like: "And before we consider overturning a fundamental tenet of Scots law, perhaps we should expect young women to change their risky and self-destructive behavior." (B34) demonstrate that blame is still often projected onto (female) victims rather than the perpetrators. This perpetuates these myths.

Both the tabloid and broadsheet press utilize the "Vulnerable victim" frame. However, since the broadsheet press tends to address the topic of male rape from a less personal point of view (e.g., law reviews), this frame is observed more frequently in the tabloid press.

4.2.2 "Brave victim" frame

The "Brave victim" frame attributes qualities such as bravery, strength, and courage to male rape victims who come forward, as seen in comments like, "it is very unusual for a man to come forward after this kind of incident, and he was brave enough to do it" (T34). This frame appears almost exclusively when rape victims are the focus of the article, which is, however, rare. Speaking out is associated with breaking the culture of silence around male rape: "I am determined to help break the silence on a subject still seen as a taboo." (T26)

The "Brave victim" frame is less prevalent than the "Vulnerable victim" frame and particularly found in recent, victim-centric reporting. No significant differences were found between the broadsheet and tabloid reporting regarding this frame.

4.3 Perpetrator frame: "Sexual predator" frame

One primary perpetrator frame emerged in the analysis: The "Sexual predator" frame. The perpetrator was directly labeled as "sexual predator" (T10), "evil predator" (T32), or "sex beast" (T28). This language creates an inhumane image of the perpetrator, likening them to a monster that preys on victims. In addition, perpetrators are described as "Psychopath[s]" (T15) or "sado-masochistic" (B5), which creates a dissonance between the image of a "normal person" and that of a rapist. There is often extensive background reporting on perpetrators, including details such as the attacker's marital status (B30) or education (T15). Emphasis is placed on prior offenses and whether the perpetrator has previously exhibited (sexually) aggressive behavior, especially in the tabloid press. Both tabloids and broadsheets commonly portray perpetrators as sexual predators, supporting the rape myth that perpetrators are sex-starved psychopaths. The tabloid press more frequently includes details on the perpetrator's previous offenses and aggressive behavior, while the broadsheet press often includes external statements by the police and courts to emphasize the "Sexual predator" frame.

4.4 Portrayal of female perpetrators

The analysis revealed that nine articles explicitly discuss female perpetrators of male rape. Due to the limited sample size, it was not possible to deduce issue-specific frames. However, an in-depth analysis following Mayring's inductive approach revealed certain tendencies in reporting. Generally, the legal context surrounding male rape was discussed: Rape by female perpetrators is recognized and referred to as a "last taboo" (F2). The articles convey the perception that female perpetrators are more likely to be victims themselves. There is greater emphasis on first proving the allegations against women before labeling them as perpetrators compared to men. The articles often provide elaborate backstories on why women become perpetrators. These backstories situate them within traumatic narratives, such as being forced to work as a "sex-worker" or in "nude-modelling" (F3). This portrayal creates an almost pitiful impression of the perpetrators. Furthermore, rape is often framed within a "love story" narrative (F3). In some cases, a woman allegedly wanted to

"win her man back" (F3) or rape was said to be caused by male rejection (F6). Female-on-male rape is exclusively depicted as acquaintance rape, implying that it does not occur outside of a relational context. While this agrees with findings showing female perpetration is much higher for acquaintance rape (particularly compared to stranger rape) (Choudhary et al., 2010, p. 1535), this depiction is also associated with less violent behavior than rape by male perpetrators, focusing on blackmail, threats, and lies, rather than physical force, which is mentioned as being used "more seldom" (F2). Portraying the situation in this way makes rape seem less severe. The term "rape" is often replaced with words including "lovemaking" (F3) or "sex act" (F6), and stronger emphasis is placed on other crimes, like kidnapping (F3).

Interestingly, the focus on appearance that was previously noticed regarding male perpetrators is also applied to male victims, emphasizing that the scenario deviates from the norm. For example, a victim's family status (F1) or physical size (F3) is highlighted. The occurrence of female perpetrators is portrayed as almost sensational, with headlines such as "Mormon Sex Slave" or descriptors like "bizarre" (F3).

In recent years, the topic of male rape has also been associated with transgender rights. Articles now address the issue within the broader debate about the distinction between sex and gender. The media provides a platform for a TERF (Trans Exclusionary Radical Feminist) narrative, and by using harsh and accusatory language, trans rights are questioned. Deliberate misuse of the perpetrators' pronouns reflects an anti-trans stance. Women are portrayed as the real victims, as they are purportedly even more endangered by transwomen. The articles frequently shift focus away from the male victims to engage in a larger debate about trans rights in the UK.

5. Discussion

As anticipated, and in line with previous research on female rape, the analysis identified three types of frames: Situational frames, victim frames, and perpetrator frames (see Li et al., 2017, p. 775). Situational frames, which encompass general perceptions of rape as well as specific situations, were the most frequently observed, ultimately leading to the identification of six distinct frames. Two victim frames were identified: The "Vulnerable victim" and the "Brave victim" frame. The former was more prevalent, while the "Brave victim" frame appeared primarily in more recent news coverage. Additionally, the analysis revealed a single perpetrator frame – the "Sexual predator" frame – and provided first insights toward the portrayal of female perpetrators of male rape.

Overall, the UK print media reporting on male rape reflects existing UK legislation on the crime. Only nine articles explicitly address female perpetrators, and even in these cases, female perpetrators are often portrayed as victims themselves. While most articles acknowledge male victims, the "Male rape = gay rape" frame links the crime predominantly to a homosexual context. Since rape is framed as limited to male actors, sex-role socialization is further influenced by sexuality. Female stereotypes are projected onto male victims of rape, placing them in a subordinate role to perpetrators. This finding supports Baker and Baker's (2019) conclu-

sion that the press endorses stereotypes and connects masculinity to attributes of power and strength (p. 380). The stereotypical representation of men and women is further expressed through the "Vulnerable victim" and "Male dominance" frames. Rape is associated with male power and sexual dominance, affecting both perpetrator and victim depiction. This aligns with previous findings that rape myths, shaped by patriarchal ideals, remain common in reporting on rape (Hindes & Fileborn, 2020, p. 643). It also supports that male rape is rooted in the patriarchal oppression and dominance over others (Brubaker, 2021, p. 724).

The results indicate that myths are commonly supported within perpetrator frames. The frames promote the depiction of perpetrators as monsters (VanSlette & Hinsley, 2017) or sociopaths (O'Hara, 2012), as seen in the "Sexual predator" frame. The exclusive categorization of perpetrators as inhumane predators poses a danger to the perception of rape, though. As Mack and McCann (2021) suggest, portraying perpetrators as monsters creates an image of stranger rape. This excludes the danger or downplaying of acquaintance rape and further implies that rape is a "random act of violence" (p. 105). This aligns with the priorly discussed findings of Choudhary et al. (2010) that acquaintance rape (including by intimate partners, parents/stepparents, friends and coworkers) is more prevalent than stranger rape (although it must be acknowledged that in the stranger category, 39.35%, 34.87%, and 19.48% of strangers across all three victimization categories were male perpetrators) (Choudhary et al., 2010, p. 1535). This view is reinforced by the "Violent attack" frame: While rape is acknowledged as a crime – contrary to findings that rape is often viewed solely as a sex act (Kitzinger, 2013; Young & Maguire, 2003) – it is not accorded the same degree of seriousness as female rape. The lexical choices like "attack" and avoiding the term "rape" contribute to understating the crime. Previous studies have documented the use of rape myths (e.g., Bonnes, 2013; Nilsson, 2019). Interestingly, this analysis revealed that articles both apply and criticize rape myths. Victims were seen with more open-mindedness than previously found. Articles try to tackle the "Culture of Silence" and have recently started using a "Brave victim" frame. This, however, still only pertains to male victims of male perpetrators.

Rape is primarily situated within a broader political narrative, ranging from critique of current rape laws to discussion of critical societal issues such as immigration and trans rights. The articles often provide a platform for extreme views and trivialize male rape by using it merely as a foreground to display a broader political agenda. The "Royal Scandal" case is an example of using rape as sensational gateway to discuss the monarchy. As Hindes and Fileborn (2020) stated, news coverage of rape is characterized by a high degree of sensationalism (p. 640).

The "Soap opera" frame stands out in the tabloid press, especially regarding the show *Coronation Street*. The reporting on the television show constitutes a meta-awareness of the issue, as articles stress the importance of the media in addressing the topic. It is not surprising that this specific frame is almost exclusively found in the tabloid press, as broadsheets do not regularly report on soap operas and cater to a different audience (Glaas, 2015, p. 27).

In summary, UK newspaper reporting about male rape endorses sex-role socialization in Great Britain. Tabloids and broadsheets apply similar framing devices,

although tabloids tend to adopt a more sensationalist style. The frames reinforce sex stereotypes and rape myths, as suggested by prior research (e.g., Kassing et al., 2005). Female-on-male rape is largely neglected, as reflected by the law. This limits male rape only to certain situations and actors. This is problematic for several reasons: Newspaper audiences tend to adopt the perspectives presented in the media. By reinforcing sex-role socialization, newspapers perpetuate these socialization processes and maintain the prevalence of rape myths and sex-role socialization. The crime of male rape is not fully acknowledged in terms of its seriousness. This is further supported by the reluctance of men to come forward, resulting in a high estimated number of unreported cases. Victims of both female-on-male and male-on-male rape may hesitate to report the crime or might not even recognize it as rape. Undeniably, it is more difficult to challenge sex stereotypes and rape myths in a country that limits its legal definition to only fragments of the full crime. Therefore, it is crucial that the media addresses male rape comprehensively, as it plays a significant role in shaping public perception.

6. Conclusion

The qualitative analysis of articles about male rape in the UK revealed that, although male rape is recognized as a crime, it is predominantly limited to a homosexual context. Consequently, rape remains a gendered term in UK print media, and common rape myths are prevalent in reporting. This indicates that sex stereotypes and patriarchal structures are deeply entrenched in UK society. This study advocates for rethinking the current definition of rape and expanding it to a non-gendered framework that includes male victims, female perpetrators, and non-binary and transgender individuals. Rape should not be viewed solely as a feminist issue but rather addressed with an all-inclusive approach. It is important to expand research on rape and include male rape within the field of study. The literature review revealed that much of the previous research limits the definition of rape to female victims by male perpetrators. Shifting the public discourse on male rape is an important step to ending the stigmatization and victimization of rape survivors. As a result, more victims may come forward, and support for female, male, and non-binary victims alike will be improved. This shift also implies changes in rape reporting, as the media can challenge current laws, raise awareness, and educate its audience. The media should recognize rape as a non-gendered crime and include male rape to spread awareness. The small number of articles addressing the topic over the past 30 years suggests that the issue is known to only a limited audience. Moreover, reporting should ensure equal representation of victims and perpetrators. Avoiding rape myths and gender stereotypes is essential to eliminating false assumptions about rape and changing public perception.

The objective of this research was to expand the study of rape frames in (UK) print media beyond the focus on female rape. Multiple frames – situational, victim, and perpetrator – regarding male rape were identified and scrutinized, considering potential media effects on the audiences of broadsheet and tabloid press. Further research should expand the field of male rape across different media, including digital spaces. A recent study by Gundersen and Zaleski (2021) showed that dis-

closing rape online had a positive impact on both male and female survivors. As the field is rapidly evolving, with rape increasingly discussed in digital contexts – for example, digital rape in the metaverse (Horne, 2023; Shariff et al., 2023) – such developments should be included in the analysis of (male) rape. Furthermore, the current research paves the way for further investigation into the effects of male rape frames and, hopefully, eventually expands the field beyond the binary of male and female, including considerations for non-binary and trans persons.

This study is not without limitations. It focused solely on male rape reporting in the UK; therefore, expanding research to different countries and comparing it directly with narratives of female rape is highly recommended. Furthermore, due to the limited number of articles, changes over time had to be disregarded. The method of qualitative content analysis was chosen to facilitate a detailed examination of the textual material, as the topic of male rape in print media has scarcely been studied. However, this method means that the results should be interpreted with caution. The identified frames are issue-specific and cannot be generalized outside the context of male rape. The coding was conducted by a single researcher; however, by applying Krippendorff's (1980) quality criteria of qualitative research, a high level of validity was sought.

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SCM
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FULL PAPER

Toward a standardized group survey. Introducing a new approach to group-level measurements in communication studies

Auf dem Weg zur standardisierten Gruppenbefragung. Ein neuer Ansatz für Messungen auf Gruppenebene in der Kommunikationswissenschaft

Johanna Schindler

Dr. Johanna Schindler, LMU Munich, Department of Media and Communication, Akademiestr. 7, 80799 Munich, Germany. Contact: johanna.schindler@ifkw.lmu.de. ORCID: https://orcid.org/0000-0002-1182-5804

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Johanna Schindler

Abstract: Many phenomena relevant to communication studies occur at the group level, yet methodological options for collecting data from groups as analytical units are limited. This contribution proposes the idea of a comprehensive, standardized, online group survey approach designed for dyads and small groups. Unlike conventional methods, the group survey approach can simultaneously account for group constructs' interactivity and heterogeneity, measure unobservable constructs, and be applied efficiently to large samples. It could also facilitate experiments, longitudinal studies, and multilevel analyses with natural groups across diverse communication contexts. This paper lays the groundwork for the group survey approach in three steps. First, it contextualizes the approach theoretically and methodologically. Second, it introduces its core principles, implementation, advantages, and limitations. Third, it tests its practical applicability through a qualitative analysis of the collective response process. The paper concludes by outlining the next steps for validating the group survey approach.

Keywords: Group research, communication research, methodology, survey research, small groups, dyads

Zusammenfassung: Obwohl viele für die Kommunikationswissenschaft relevante Phänomene auf Gruppenebene auftreten, sind die methodischen Möglichkeiten zur Datenerhebung bei Gruppen als Analyseeinheiten begrenzt. Dieser Beitrag stellt die Idee eines umfassenden, standardisierten Online-Gruppenbefragungsansatzes vor, der für Dyaden und Kleingruppen konzipiert ist. Im Gegensatz zu herkömmlichen Methoden kann der Ansatz gleichzeitig die Interaktivität und Heterogenität von Konstrukten auf Gruppenebene berücksichtigen, nicht-beobachtbare Konstrukte messen und effizient für große Stichproben eingesetzt werden. Er könnte Experimente, Längsschnittstudien und Mehrebenenanalysen mit natürlichen Gruppen in diversen kommunikationswissenschaftlichen Kontexten ermöglichen. Der vorliegende Beitrag schafft in drei Schritten die Grundlagen für den Gruppenbefragungsansatz. Erstens wird der Ansatz theoretisch und methodisch kontextualisiert. Zweitens werden seine Grundprinzipien, Umsetzung, Vor- und Nachteile vorgestellt. Drittens wird seine praktische Anwendbarkeit anhand einer qualitativen Analyse des kollektiven Antwortprozesses getestet. Der Beitrag schließt mit einem Ausblick auf die nächsten Schritte zur Validierung des Gruppenbefragungsansatzes.

Schlüsselwörter: Gruppenforschung, Kommunikationswissenschaft, Methodik, Befragung, Kleingruppen, Dyaden

1. Introduction

Communication scholars repeatedly have underscored the importance of social environments and group processes for media effects across subfields, ranging from political, health, and science communication (Southwell & Yzer, 2007), to entertainment (Cohen, 2017; Tal-Or, 2021). Smaller groups from everyday life – such as families, friends, or colleagues – are of particular importance in this context. First, this is due to the prevalence of group interactions related to media. A significant share of media content is consumed (GfK, 2019) and processed collectively through conversations (Gehrau, 2019). Teamwork is also essential for media production (Wang et al., 2022). Second, this arises from the specific properties of group information processing. Experimental comparisons have demonstrated that groups function as meaningful entities that think and act differently compared with each of their members (see Kerr & Tindale, 2004, for an overview). These results highlight that the meso level often serves as the crucial link between the micro and macro levels. Therefore, considering group constructs – such as collective perceptions, attitudes, affects, and behaviors – is essential to gain a deeper understanding of both individual and societal phenomena relevant to communication studies. For example, it can help in better understanding how political polarization evolves within and between social circles (Levendusky & Stecula, 2023) how media literacy develops within families (Riesmeyer et al., 2019), and how decisions emerge in newsrooms (Wilczek, 2019). However, most communication studies focus on the individual level. An individual perspective often even applies to dedicated group research:

> *"Although most group researchers believe that behavior in groups should be explained at the group, rather than the individual level of analysis, their theories and methods often betray subtle forms of reductionism. 'Group' research often focuses on the thoughts, feelings, and actions of individuals embedded in group contexts, rather than the responses of the group as a whole" (Levine & Moreland, 2011, p. 384).*

In addition to challenges in operationalizing group-level constructs (e.g., collective attitudes or group norms), group studies often encounter further methodological issues, including time-intensive data collection and analysis (Brauner & Scholl, 2000). Computational methods have advanced the possibilities of collecting and analyzing group-related digital behavioral data substantially (e.g., Pilny, 2021). However, group phenomena that occur offline remain underexamined, particularly when they are unobservable. While self-report methods for individuals range from qualitative interviews to fully standardized quantitative surveys, to date, only qualitative approaches have been established for group interviews in communication studies (for an overview, see Beck et al., 2021). Limited methodological options, in turn, make it difficult to empirically test group-level theory, further exacerbating the lack of group research both within and outside of communication studies. For example, theories of collective information processing (Hinsz et al., 1997) or collective decision-making (Kerr & Tindale, 2004) could provide

valuable insights into media consumption and production, but require group-level measurements for empirical testing and refinement.

In addressing this methodological gap, the present contribution introduces a novel standardized online survey approach directed at groups, which are minimally defined as "two or more people" (Williams, 2010, p. 269) to account for their many possible manifestations. This paper lays the groundwork for the group survey approach in three steps. First, it contextualizes the approach by outlining the theoretical foundations of groups as units of analysis and reviewing different methodological approaches to measuring group constructs and their associated challenges. Second, it introduces the group survey approach, detailing its core principles, implementation, advantages, and limitations. Third, it tests its practical applicability through a qualitative observation study that examines the group response process. While this contribution does not aim to present a fully validated methodological approach at this early stage of development, it outlines the next steps necessary for validation.

2. Step 1: Contextualizing group-level measurements

2.1 Theoretical foundations of groups as units of analysis

Small-group research has long offered insights into the dynamics of group interactions that build the foundation of all group-level constructs. Hinsz et al. (1997) established a theoretical framework to treat groups as meaningful information-processing systems. According to this framework, groups can process information similarly to individuals, involving objectives, attention, encoding, storage, retrieval, processing, responses, and feedback. This processing relies on social sharedness (Hinsz et al., 1997), which encompasses shared states and processes among group members, such as information, motives, attitudes, norms, identities, cognitive processes (Tindale & Kameda, 2000), and emotions (Hinsz & Bui, 2023). Social identity (Tajfel & Turner, 1986) can be viewed as a comprehensive form of social sharedness. Based on social sharedness, groups can combine contributions by a) identifying relevant contributions (e.g., resources, skills, and knowledge) and b) interactively combining them into a new process at the group level (e.g., through aggregation, linking, or transformation) (Hinsz et al., 1997). Notably, this notion of collective information processing extends beyond mere cognitive tasks, such as problem-solving, and includes collective perception, thinking, feeling, and acting in the broadest sense.

Apart from its structural similarities with individual information processing, collective information processing is inevitably also shaped by group-specific factors, such as group norms, internal majorities, and leaders. Extant research has shown that individuals often conform to group influences due to internalized social identities as group members (Hogg et al., 2004; Tajfel & Turner, 1986). From this perspective, such influences are not confounders but rather inherent and functional components of the collective process. They help groups facilitate identity and unity (Hinsz et al., 1997; Hogg et al., 2004; Tindale & Kameda, 2000) and protect them against flawed perceptions (Caporael, 1997). Accordingly, group lea-

ders can be viewed as central group members who serve the group, rather than vice versa (Hogg et al., 2004). Despite groups' tendency to converge, their members are not automatically homogeneous in every respect. Groups still can display internal heterogeneity due to their members' diverse beliefs, perceptions, affects, or behaviors (Hinsz et al., 1997; Hinsz & Bui, 2023; Hogg et al., 2004).

Thus, group processes and related constructs emerge from individuals' social minds and collaboration and exceed the sum of their parts. Various experimental comparisons have demonstrated that groups think differently from individuals (for overviews, see Kerr et al., 1996; Kerr & Tindale, 2004). For example, groups can solve complex problems more efficiently than individuals (Almaatouq et al., 2021). Depending on their composition, they can exhibit stronger or weaker confirmation bias than individuals (Schulz-Hardt et al., 2000). Groups also have a collective intelligence factor that cannot be explained through their members' individual intelligence (Woolley et al., 2010).

Consequently, group constructs should be conceptualized and measured at the *group level* to capture their interactive nature. More specifically, group researchers have asserted that the theory, measurement, and analysis units of group constructs should refer to the same level or relationship between levels (Levine & Moreland, 2011; Rousseau, 1985). Rather than measuring individual group members' aggregated or nested attitudes, perceptions, affects, or behaviors, an accurate group-level measurement can capture the whole group's collective attitudes, perceptions, affects, or behaviors. Put more simply, a family's favorite meal may be pizza, while its individual members' favorite meals may be risotto, fish, and pasta. Asking individual members for their favorite dish would not help determine what to serve to make the whole family happy. Simultaneously, measurements of group-level constructs ideally also should consider potential internal *heterogeneity*. If no collective group attitude has developed, an accurate group-level measurement would capture how diverse the individual positions within the group are. Returning to the family-meal example, if the family shares no specific favorite meal, understanding individual preferences in relation to each other would help determine that the whole family still would be happy in an Italian restaurant.

2.2 Methodological approaches to group-level measurements

The following sections review existing qualitative and quantitative approaches for collecting group-level data in communication studies. The approaches are categorized broadly into observational and self-report methods. Each approach is assessed based on the two group-specific criteria derived above, i.e., whether it can capture groups' interactive nature (group level) and potential internal diversity (heterogeneity). Furthermore, it is discussed in the context of three criteria generally relevant to data collection methods (see, e.g., McDonald, 2008), namely its ability to grasp unobservable constructs (introspection), its degree of reactivity (nonreactivity), and its applicability to large samples to gain generalizable results (efficiency; see Table 1 for an overview).

Table 1. Core strengths (+) and weaknesses (–) of methodological approaches for measuring group-level constructs

	Observational approaches				Self-report approaches			
	Qualitative observation	Quantitative observation	Computational observation	Qualitative interview	Aggregation methods	Consensus method	Group survey
Group level	+	+	+	+	–	+	+
Heterogeneity	+	+	+	+	+	–	+
Introspection	–	–	–	+	+	+	+
Nonreactivity	+	+	+	–	–	–	–
Efficiency	–	–	+	–	+	–	+

2.2.1 Observational approaches

One option to operationalize group-level constructs is observational approaches. Digital behavioral data from mediated group conversations, such as those on social media (Rothut et al., 2023) or private messaging apps (Knop-Huelss, 2023), can be collected via scraping or data donations. Face-to-face conversations and interactions need to be observed in laboratories (e.g., Sommer, 2013) or in the field (e.g., Lull, 1980) and often are recorded and transcribed for further analysis. Observational data can be analyzed using qualitative (e.g., Lull, 1980), quantitative (e.g., Knop-Huelss, 2023; Sommer, 2013), or computational methods such as automated content and network analyses (e.g., Rothut et al., 2023). Digital group data collected for computational analyses will be categorized under the term computational observations.

Observational approaches in group research are effective for capturing group-level interactions and within-group heterogeneity, fulfilling the requirements for group-level measurements. Observational measures are typically also less reactive than self-report methods. However, they are limited to observable behaviors and cannot directly access implicit group aspects, such as collective knowledge or beliefs. Furthermore, collecting and analyzing observational group data is typically time-consuming, particularly from face-to-face interactions that need to be recorded and transcribed. While automatic transcription software can assist, it still requires human oversight (Wollin-Giering et al., 2023), particularly for distinguishing multiple voices. Manual qualitative or quantitative analyses of group conversations are also labor-intensive. Computational text analysis methods can be used to process large amounts of data efficiently, but they struggle with capturing complex constructs (Baden et al., 2022) that are particularly relevant for group-level analysis.

2.2.2 Self-report approaches

Self-report approaches offer another way to capture group-level constructs. Individual interviews or surveys are not considered here, as they focus on individuals within the group context. The most established group-level self-report method in communication studies is qualitative group interviews (group discussions, focus groups), which are recorded and transcribed for analysis (e.g., Swart et al., 2019). While quantitative surveys of groups are uncommon in communication research, organizational research offers two relevant approaches. First, aggregation methods aggregate individual survey responses to represent the whole group (Huang et al., 2009). Second, the consensus method (also termed consensus rating, consensus technique, or discussion method) involves surveying entire groups in a laboratory setting. With this method, a researcher asks the group to reach a shared response on a standardized scale (e.g., Quigley et al., 2007).

Each self-report approach presents unique strengths and weaknesses for group research. Qualitative interviews and the consensus method can address the whole group and its interactions, while aggregation methods miss the interactive component. Qualitative interviews and aggregation methods can capture group hetero-

geneity, whereas the consensus method compels groups to provide a shared response. All self-report methods can access implicit aspects of group processes, such as collective knowledge or beliefs. However, they are also more reactive than observational approaches in two ways: They require active reflection on the constructs being measured and may elicit social desirability bias (McDonald, 2008). Furthermore, qualitative interviews and the consensus method demand substantial effort. Despite its standardization, the consensus method remains resource-intensive, requiring instruction from a researcher for each participating group.

2.3 Overarching challenges

Researchers can choose from various approaches to measure group-level constructs (see Table 1 for an overview). Qualitative approaches offer in-depth insights into complex group processes, while quantitative approaches provide systematic and generalizable results. However, even most quantitative group approaches are labor-intensive and challenging to implement with large samples. Exceptions are limited to observable constructs (computational observations) or miss the interactional dynamics of group-level constructs (aggregation methods). An efficient self-report approach that includes groups' interactional components is still needed. While the consensus method has made initial progress, the full potential of a standardized group survey for communication studies has yet to be realized.

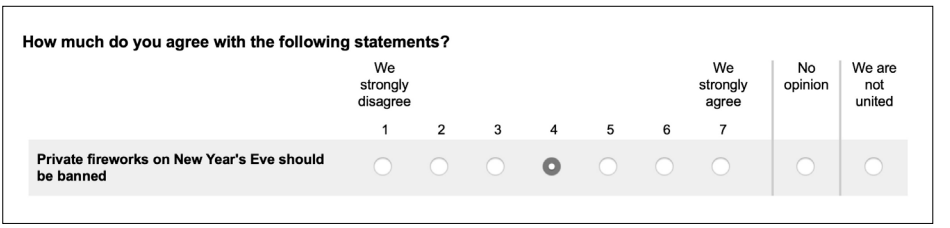
3. Step 2: Introducing the group survey approach

3.1 Core principles and implementation

The group survey approach is a standardized, large-scale online survey approach for measuring group-level constructs (see Schindler, 2023, for a detailed development and test). The questionnaire is designed for groups and can be completed collectively by any group capable of interaction. The groups can complete the questionnaire on a single device while being physically together. Alternatively, they could collaborate through technical means, though this option has yet to be tested (see below for details). Thus, a group survey serves as a group-level counterpart to individual online surveys. In line with the theoretical foundations of group-level measurements presented above, the approach is defined by two core principles.

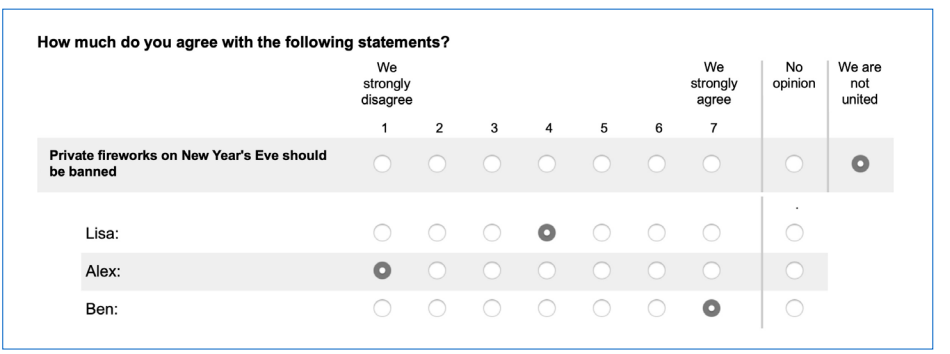
First, the entire online questionnaire addresses the *group level*. Building on the concept of groups as effective information processors, this principle extends the idea of single consensus measures to a whole online survey that groups can answer independently outside the laboratory. The measurement of group-level constructs requires careful theoretical reflection on their level of analysis. Group constructs can then be translated into suitable survey questions and response options that address the group consistently (e.g., "we strongly agree"). Furthermore, scale points can be numbered to help the groups discuss different response options (see Figure 1).

Figure 1. Example question with a collective response



Second, acknowledging that group members do not always share identical characteristics and perceptions, the group survey approach also includes a novel measure of within-group *heterogeneity*. When lacking consensus, groups can select a residual disagreement option ("We are not united"). If measurements require a consistent assessment across all group members (e.g., on previous group behavior), "not united" can be treated as a missing value. However, when heterogeneous assessments are relevant (e.g., indicating opinion diversity), individual response options can be set to appear dynamically if groups select "not united" (see Figure 2). These individual responses can then be used for further calculations (e.g., the standard deviation of opinions to represent opinion diversity).

Figure 2. Example question with individual responses



Note. Individual response options appear dynamically when groups select "not united."

From a group-level perspective, a group's influence on its members is no confounder, but rather an integral part of the research subject. For example, measuring group norms through a group survey captures the norms as they are negotiated collectively by the group, accounting for social influences. In contrast, an individual survey assesses norms as perceived by individual group members (e.g., Geber et al., 2019). Both approaches are valuable but have a different focus: A group-centered approach is better for understanding group-level dynamics, such as shared group norms' influence on collective behavior, while an individual-centered approach is more effective for examining individual processes within group contexts, such as how perceived group norms influence individual behavior. When

both group-level and individual-level perspectives are relevant, a group survey can be combined with individual surveys of members. This approach allows for excluding group influence from specific measurements while incorporating it in others.

In addition to these two core principles that define a group survey, further considerations are relevant to implementation. Regarding *participation instructions*, a minimal approach would be to inform the groups about general principles at the beginning of the questionnaire. Here is an example: "The following questions address you as a group. If you share one opinion, choose the position closest to your shared answer (see Figure 1). If opinions differ, select "We are not united" (see Figure 2), and additional options will appear." This approach has the advantage that the groups can coordinate in their own way, making responses particularly spontaneous and natural. It was chosen in the exploratory study presented below. However, if a study requires greater control over the response process, more concrete instructions could be provided, similar to those used in the consensus method (e.g., Quigley et al., 2007).

Just as most individual surveys collect data on basic sociodemographic characteristics, group surveys also can capture data on *context characteristics*, such as group type and size. Furthermore, individual members' sociodemographic data can be aggregated at the group level using means, percentages, or standard deviations to describe groups based on attributes such as average age, age diversity, gender ratio, or educational composition (Schindler, 2023).

Another important issue is *data quality*. First, for group data to be valid, all members must feel represented by it. Individual follow-up surveys can help assess whether each member agrees with the group's answers and felt free to express their views during the process. Importantly, this does not aim to eliminate group influence on members – as it is an inherent part of the phenomenon under study – but to ensure that their responses are not shaped by extrinsic pressure. Second, overall data quality may vary, such as if the questionnaire was not taken seriously or if responses were generated by only one person. As in individual surveys, group data quality can be evaluated using techniques such as speed indices, checks for inconsistent response patterns, or analysis of answers in open text fields (Schindler, 2023).

Implementing a group questionnaire that incorporates individual measures involves specific *technical requirements*. SoSci Survey (Leiner, 2019) is a useful tool that enables dynamic integration of user-defined pseudonyms for individual responses within group surveys using placeholders and JavaScript. If individual follow-up surveys are needed, datasets can be linked anonymously using IDs, with group meta-information stored in an internal database. Furthermore, it is recommended that groups complete surveys on devices with larger screens, such as tablets or laptops, rather than smartphones, to ensure all members can participate effectively.

Finally, *recruitment* can be managed by engaging individual members to mobilize the rest of the group. The exact approach should be tailored to the target audience. For example, online panels that provide data on relationship status and household size can be utilized to target members of partnerships, families, or

shared apartments. Importantly, participation demands a high level of effort from the groups, particularly larger ones that need to meet in person, and may require incentives to ensure motivation (see the limitations section below for details).

Importantly, these are initial suggestions that require systematic testing and further refinement through methodological research – for example, investigating the effects of different participation instructions.

3.2 Benefits

The group survey approach offers decisive benefits for communication research. As demonstrated above, most approaches to group measurements are either insufficiently situated at the group level, are limited to homogeneous responses or observable measures, or are resource-intensive. The group survey approach can overcome these problems simultaneously. First, it comprehensively addresses the group level of analysis by incorporating a group's interactional nature. Second, it can operationalize within-group heterogeneity through its disagreement option. Third, it enables access to introspective information, allowing for measurement of unobservable group constructs without being limited to them. This versatility allows for the measurement of a wide range of constructs, from collective perceptions and attitudes to affects and behaviors. Fourth, a group survey is efficient and can be employed to study large group samples, ultimately leading to more generalizable results from group research.

Through this combination of features, the group survey approach opens new possibilities for communication studies in several areas. It simplifies data collection at the group level, allowing for analysis using standard statistical procedures. Media stimuli can easily be embedded into group surveys, enabling experiments with groups such as families, friends, or colleagues as units of analysis. Such experiments could help understand collective media effects and compare group processes with individual processes. Unlike a significant portion of previous group research, these studies can be conducted in a natural setting outside the laboratory to enhance ecological validity. Furthermore, the group survey approach facilitates longitudinal studies with groups. They could offer insights into the long-term dynamics of collective processes in natural groups, such as political polarization. Finally, the approach supports multilevel studies, combining group surveys with individual data to understand the interaction between group and individual processes, such as in the realm of collective opinion formation and decision-making.

3.3 Limitations

Despite its advantages, the group survey approach comes with certain challenges. First, while data collection is efficient, recruiting groups is challenging, as they need to coordinate themselves. Attractive incentives might encourage them, but could also lead to individuals mimicking group responses. Thus, group surveys may require both strong incentives and verification techniques, which could include prospective methods, such as smartphone registration, or retrospective me-

thods, such as data quality checks (see above). Future research could identify the most effective group recruitment and verification strategies.

Second, as a self-report method, the ability to measure unobservable constructs only works at the cost of reactivity (McDonald, 2008). Extant research has demonstrated that a higher salience of group norms can mitigate the influence of general societal norms on collective behavior (Reicher et al., 1995), implying weaker social desirability effects in a group context. However, it remains to be examined empirically whether and under which conditions group surveys are more, less, or equally reactive compared with individual surveys.

Third, the approach requires groups to collaborate through direct interactions, i.e., they must be able to communicate in some form. So far, it has been applied only with group members being physically present. However, a digital solution, such as completing the survey together via video chat, should also be conceivable and would need to be tested empirically. Furthermore, this requirement implies a limitation on the number of group members to ensure effective collaboration. Previous studies using the consensus method in the laboratory have worked with up to six (Gibson et al., 2000; Quigley et al., 2007) or even ten or more members (Kirkman et al., 2001), offering some guidance on appropriate group sizes. For larger groups, one possible solution is to select a representative or theoretically relevant subgroup, similar to how random or stratified samples of individuals are used to represent a population. This approach may offer a more feasible way to approximate group characteristics and dynamics, though it requires empirical validation.

Fourth, while a group survey can capture emergent and contextual aspects of group phenomena, it cannot fully analyze their dynamics and complexity. Like any survey, it relies on active reflection, potentially overlooking unspoken and unconscious elements (McDonald, 2008). Furthermore, as a standardized method, it enhances generalizability at the expense of detail and nuance. Consequently, a group survey can only complement, but not replace, qualitative methods in group research.

Despite these limitations, the group survey approach combines a unique set of strengths that enable more and more diverse quantitative group research within and beyond communication studies (see above). Therefore, pursuing this approach further appears worthwhile. After a conceptual beginning has been made, questions arise regarding its practical applicability and, ultimately, its validity.

4. Step 3: Testing the group survey approach's applicability

4.1 The emergence of group survey responses

To assess the group survey approach's practical applicability, this section examines the collective response process empirically. It aims to determine whether and how a group survey can be completed effectively by both the group as a whole and its individual members. This step is a crucial precondition for the implementation, quantitative validation, and interpretation of group surveys.

Extant research has demonstrated that individuals reach survey responses through different processing routes (for an overview, see Tourangeau, 2018). This plausibly also applies to groups. Research on group decision-making and problem-solving has revealed diverse strategies that groups employ to achieve collective outcomes. Depending on the context, such strategies include discussions based on arguments, combining preferences, or following leaders (for overviews, see De Dreu et al., 2008; Hinsz et al., 1997; Kerr & Tindale, 2004; Levine & Moreland, 2011). However, these studies typically focus on specific tasks, such as jury decisions or mathematical problems, rather than collective self-assessment in survey contexts. Consequently, the emergence of group survey responses remains a black box that needs to be opened. As derived above, group measures must stem from a genuine and independent group process to which all members contribute. It only makes sense to pursue and validate the group survey approach in quantitative studies when this condition is met in practice. Furthermore, comprehending the response process is vital for interpreting standardized group survey data. While the analysis can be conducted easily through standard procedures, the interpretation demands a deeper understanding of how group responses are formed to assess what they convey (or do not convey) about the group and its members.

Given the limited understanding of the collective response process to a group survey so far, an exploratory research question is posed: *How do groups reach responses to group survey questions?* This open-ended question accounts for the potential diversity and complexity of the response process. It encompasses all interactions leading to group survey responses, such as how groups handle consistent and divergent assessments, what decision strategies they employ, and when they choose the disagreement option. Ultimately, answering this question helps determine whether they reflect genuine group processes. Furthermore, it enhances their interpretability by illuminating how exactly group responses can emerge.

4.2 Method

The research question on the collective response process has been answered through an exploratory, qualitative observational study, with eight natural groups participating in an online group survey (see Schindler, 2023, for a detailed analysis). While it initially may seem counterintuitive to investigate a standardized survey approach through qualitative observation, employing a non-standardized approach was essential at this early stage to examine the response process comprehensively. An observational approach was an appropriate choice of method, as groups unavoidably think aloud when negotiating group-level responses and simultaneously may not be consciously aware of their response practices.

4.2.1 Example group survey

The online questionnaire was part of a broader project on group processing of media messages, focusing on two randomly assigned controversial topics: Car-free cities and same-sex parenting (Schindler, 2023). During the survey, groups watched a five-minute video stimulus on their topic from a German knowledge

show and discussed it collectively. Before and after the stimulus, standardized group-level measures were employed regarding attitude, perceived public opinion, issue involvement, knowledge, affects during stimulus consumption, stimulus evaluation, systematicity and openness of information processing, and affects and collaboration patterns during information processing. The measures used nominal or seven-point scales, all including the "not united" option. Most measures allowed for individual responses if no consensus was reached. Furthermore, open-text-box measures were used for arguments and stimulus recall. Thus, the example group questionnaire encompassed a wide variety of constructs and measurement types, including open-text fields and metric scales, to examine response patterns as comprehensively as possible. The full questionnaire is available in the appendix (see Schindler, 2023, for the development of each measure).

4.2.2 Sample

The sample comprised eight natural groups from Germany (two to four members each, 23 individuals in total; see Table 2). The groups were recruited through personal contacts, with each participant receiving ten euros. Following theoretical sampling principles (Bryman, 1988; Silverman, 2015), groups were selected to cover diverse group features. The sample included couples, families, and friends sharing an apartment, reflecting a wide range of relationships, sociodemographic characteristics, and compositions.

Table 2. Sample characteristics

ID	Group type	Gender	Age	Education
1	Friends	All female	20s	Academics
2	Family	Mixed	Teens–40s	Academics
3	Friends	Mixed	30s	Non-academics
4	Family	Mixed	Teens–50s	Mixed
5	Couple	Mixed	20s	Academics
6	Couple	Mixed	60s	Non-academics
7	Family	Mixed	20s–60s	Mixed
8	Friends	All male	20s	Academics

4.2.3 Data collection

The observations took place between January and May 2020 in the groups' private homes.[1] Following written informed consent from each member, the groups collectively completed the group questionnaire on one device. No researcher was

1 Due to the COVID-19 pandemic, data collection in four groups was conducted digitally and only with groups who lived in one household. The groups filmed themselves and securely sent the video to the researcher.

present during the survey to ensure a realistic response. The participation process was videotaped and transcribed anonymously for subsequent analysis.
After the observation, the groups were asked for general feedback on the group questionnaire. Group 2 overlooked the "not united" option. Consequently, from Group 3 onward, this option was explained explicitly in the questionnaire (see chapter 2.1 on participation instructions). Aside from this, no general issues with the questionnaire format were identified, and the feedback was limited to specific measurements.

4.2.4 Data analysis

The data were analyzed through inductive category development in MAXQDA 2022 (VERBI Software, 2021). Categories were developed at the level of collective response decisions for each item or question and revised iteratively until new passages elicited minimal change (Mayring, 2021). After just two groups, no news categories emerged, indicating theoretical saturation in the sense of theoretical stability and consistency across different cases (Breckenridge & Jones, 2009). The main categories followed the decision-making process (see Figure 3 for an overview of the process and Table 3 for all categories). Response decisions either started from initial agreement or disagreement. In cases of initial agreement, group members expressed their consent in various ways and selected a shared response. Initial disagreement was subdivided further based on its extent and could be solved in two ways: First, groups could engage in an agreement process and use various strategies to reach a shared response. Second, they could select "not united." To improve categorization, contextual information about the group was considered. For example, prior response behavior helped clarify whether a leader generally was guiding a group. While the qualitative approach was essential for a detailed and comprehensive picture of the response process, a quantitative examination of the final codings elicited additional value. With 326 response decisions analyzed, response pattern frequencies provided an approximate idea of their consistency across groups.

4.3 Results

The results are structured along the main categories. Observations are contextualized regarding group characteristics or measurement types wherever relevant. Category descriptions are illustrated with translated and pseudonymized sections from the observation transcripts, annotated with group identification numbers and explanatory notes on the measure (see the supplemental material in the appendix for all measures). Figure 3 provides an overview of possible response process pathways, while Table 3 summarizes all categories and their frequencies per group.

Figure 3. Possible pathways of group responses

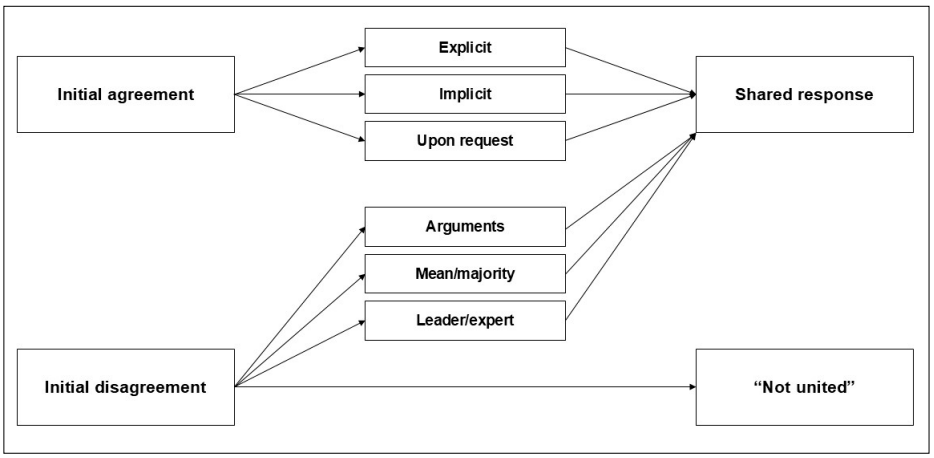


Table 3. Response process categories by group

	Group								
	1	2	3	4	5	6	7	8	∑
Initial agreement	(29)	(17)	(28)	(30)	(31)	(43)	(35)	(33)	(247)
Explicit	23	7	27	17	31	25	23	25	178
Implicit	5	9	0	12	0	17	6	5	54
Upon request	1	1	1	1	0	2	6	3	15
Initial disagreement	(10)	(19)	(5)	(14)	(9)	(0)	(13)	(9)	(79)
Small (1–2 scale points)	7	6	1	3	5	0	9	4	35
Large (3–6 scale points)	0	1	0	3	1	0	0	0	5
Not quantifiable	3	12	4	6	3	0	4	5	37
No opinion	0	0	0	2	0	0	0	0	2
Agreement strategies	(11)	(20)	(3)	(17)	(6)	(0)	(15)	(8)	(80)
Arguments	5	5	2	9	5	0	7	5	38
Mean/majority	4	13	0	5	0	0	6	3	31
Leader/expert	2	2	1	3	1	0	2	0	11
Not united	0	1	0	1	3	0	1	2	8

Note. N = 326 response decisions. The sums of subcodes are presented in parentheses. Groups could use several agreement strategies simultaneously.

4.3.1 Initial agreement

In most response decisions, all group members indicated initial agreement and quickly chose a shared response. They expressed their consent to the group response in different ways. Most of the time, each group member expressed *explicit* agreement with the group's answer. They did so verbally or nonverbally, such as by nodding:

> [Group 1: measurement: knowledge through a single-choice question, p. 8 of the questionnaire]
> Sophia: ... (reading) "What does the term 'mobility transition' mean? (...)"
> Lisa: I would say d)...
> Melissa: ...d)...
> Sophia: ...d), Yes....

Group members sometimes provided only *implicit* consent, particularly in larger groups and groups with very strong relationships (e.g., families or a long-married couple). Instead of actively confirming each response, they vetoed when they disagreed with an answer:

> [Group 2: measurement: affect on a seven-point scale, p. 15 of the questionnaire]
> Claudia: ... (reading) "Annoyed by the video" – not really...
> Thomas: ...No, no...
> Amelie: ...No...
> Claudia: ...So, more like four...
> Amelie: ...FOUR?...
> Thomas: ...NO!...
> Amelie: ...Why four? No!...
> Thomas: ...We do NOT agree! "We were annoyed by the video" – you have to say a "one" because we were NOT annoyed; otherwise, we were a little annoyed...
> Claudia: ...Not at all, we were not annoyed, right....

Sometimes, individual group members agreed *upon request*. In these cases, other group members actively checked their consent to ensure their response represented the whole group:

> [Group 8: measurement: open text boxes for arguments, p. 11 of the questionnaire]
> Philipp: ...Yes (clicks) and "professional obligations"...
> Julian: ...Actually speaks against it too... (Julian and Philipp look at Pascal)
> Pascal: ...Yes, yes....

4.3.2 Initial disagreement: Agreement strategies

In other cases, initial disagreement was expressed. However, as far as this could be quantified, it was usually rather small (one or two points on a seven-point scale). In most of these instances, groups then engaged in an agreement process and quickly agreed on a shared response. All groups relied on different and often mul-

tiple agreement strategies. A prevalent decision strategy was the exchange of *arguments*:

> [Group 5: measurement: attitude toward same-sex parenting on a seven-point scale, p. 5 of the questionnaire]
> Luise: ...Yes, I would also say "strongly agree"...
> Jakob: ... (nods, looks at Luise) Yeah?...
> Luise: ...Yes, don't you? Wouldn't you say so?...
> Jakob: ... (thoughtfully) Well, actually, yes, but – I mean, doesn't sometimes the other sex get missing as a role model?
> Luise: ...Yes, but I think it always depends on how specifically the gender fulfills that role (...) and how it's compensated. I don't think it can be generalized. (...) ...
> Jakob: ...So, not all, but yeah (…) but it only says "can"...
> Luise: ..."Can," yes, I would agree with that; yes, that's true. I would definitely agree....

Another frequent way to agree on a group response was to rely on the (intuitively built) *mean* or *majority*. It often was not clear which one applied, as both led to the same result, and they did not make their strategy explicit:

> [Group 7: measurement: issue involvement on a seven-point scale, p. 7 of the questionnaire]
> Christian: ...So, I'm at four (looks around) ...
> Karin: ... I'm also at four...
> Roland: ...I'm at five, six, at five...
> Jenara: ...Mmh, maybe five...
> Christian: ...So then I would suggest we go for...
> Karin: ...Five...
> Christian: ...Five...
> Roland: ...Five, all right....

Occasionally, groups relied on a *leader* or *expert* to find a shared answer. They used these strategies particularly in more difficult cases, such as when their discussion about different response options became repetitive. However, in most cases, they relied on single group members as experts when they had to answer knowledge questions with a time limit:

> [Group 3: measurement: knowledge through a single-choice question, p. 8 of the questionnaire]
> Alessio: 2015, right? That was 17, getting married, I'd say 17, you know? (pause) I'm almost sure. For three years now. You don't know, do you?
> Dana: I think rather, I don't know, but...
> Alessio: ...But I'm sure, 2017...
> Dana: ...OK....

Apart from this, no individual members appeared to assume any particular leadership role regarding response decisions' content. All eight group surveys were navigated predominantly or entirely by one group member, but these members consistently functioned as representatives and moderators for their groups, guiding them through the questionnaire while maintaining a cautious stance. For

example, they read out questions or asked other group members for their opinions.

4.3.3 Initial disagreement: 'Not united'

In only a few cases did groups arrive at final disagreement and choose "not united" if more substantial disagreement was expressed between group members and if group members were particularly passionate about their responses:

> [Group 8: measurement: attitude toward car-free cities on a seven-point scale, p. 18 of the questionnaire]
> Philipp: ... "Cities can function well even without cars"...
> Pascal: ...Yes, that's true...
> Philipp: ...Six – or seven. Julian, what do you think?...
> Julian: ...I'm actually leaning toward seven...
> Philipp: ...Yeah, I'm at six because it doesn't work entirely without them...
> Pascal: ...True, that's where we want to evaluate differently (...)
> Philipp: ...So, I'll go with seven (to Pascal). What about you?...
> Pascal: ...I'll go with six. It doesn't work entirely....

4.4 Discussion

This observational study examined how groups reach collective survey responses. Through qualitative analysis of 326 response decisions across eight different groups, it addressed two fundamental questions crucial for the future application and development of the group survey approach.

Regarding whether groups can respond to the survey as a whole and by themselves, the answer so far is a simple yes. Regardless of group characteristics or measurement type, collective responses consistently emerged from genuine, interactive group processes involving all members. Dominant voices did not determine the response process. Instead, group members navigating the survey acted as representatives and moderators on behalf of their groups. This observation aligns with the conceptualization of central group members serving the group – and not vice versa (Hogg et al., 2004). The groups answered the survey intuitively and independently of further guidance, reflecting that humans are inclined toward collaboration (Stevens & Fiske, 1995). These results underscore the group survey approach's practical applicability in future studies without the need to guide or control the response process.

In response to the question of how group responses emerged, the study identified three main pathways (see Figure 3 for an overview). First, members can agree unanimously from the beginning, provide consent, and select a shared response. Second, members initially might disagree but employ various strategies to reach a consensus and arrive at a shared response. Third, they can agree to disagree and choose "not united." Despite the sample's diversity, these pathways occurred consistently across groups (see Table 3).

Two aspects of the response process are particularly important for interpreting group surveys. First, group survey responses can emerge through various paths.

This also applies to individual survey responses (Tourangeau, 2018) and reflects the multifaceted and adaptable nature of human information processing. The groups used strategies familiar to other areas of group research, such as discussing based on arguments, combining preferences, and following leaders. Consistent with extant research, they also adapted their strategies to fit each question and situation (for overviews, see De Dreu et al., 2008; Hinsz et al., 1997; Kerr & Tindale, 2004; Levine & Moreland, 2011). For example, they relied more often on leaders or experts when they needed quick responses to knowledge questions. However, researchers should consider that different paths toward shared answers exist and may be influenced by the characteristics of the questions and group. If studies need to differentiate between preliminary and negotiated consensus, and between different agreement strategies underlying group survey responses, they could add corresponding questions or response options to group survey measures.

Second, groups have a strong tendency toward consensus in their responses. In about three-quarters of response decisions, the groups immediately agreed on one response. In cases in which immediate consensus was not reached, groups typically engaged in active discussions to reach an agreement. Instances of disagreement leading to selecting "not united" were rare across the groups. These observations mirror social reality, in which groups often gravitate toward homogeneous perceptions and attitudes (Hinsz et al., 1997; Hogg et al., 2004; Tindale & Kameda, 2000), particularly within close relationships (Davis & Rusbult, 2001). Thus, shared group responses can represent both pre-existing and reached agreements, reflecting the continuous dynamics of coordination and adaptation inherent in group perception, thinking, feeling, and action. Sharing information is a precondition of shared information, and vice versa (Hinsz et al., 1997). Simultaneously, groups occasionally opted for "not united" responses in cases of significant disagreement or when a response was important to individual members, indicating deliberate decisions for or against shared answers at the individual level. Therefore, researchers should be aware that the group survey approach intentionally captures groups' tendencies and dynamics toward homogeneity. While this feature is a key advantage of the approach, studies exclusively interested in pre-existing agreements may opt for individual surveys of group members instead.

4.5 Limitations

This study also contains several limitations. First, the results relied on observations of the groups' conversations and behavior. The collective response process to a group survey is relatively easy to observe, as it depends mostly on verbal communication. Still, self-report approaches could help avoid observational biases and identify implicit aspects of the response process known only by the groups. Second, even though a discreet camera conducted the observations, and the groups seemed to behave naturally, it may have caused reactivity. Future studies should test whether observed patterns also apply in contexts without observation. Ethnographic methods could also provide a more nuanced understanding of the response process.

Moreover, this study's results are qualitative, and they are limited to a small sample of closely related natural groups with up to four members in Germany. More exploratory studies should examine whether the paths toward a group response identified in this study are exhaustive. For example, they may vary depending on thematic contexts, group types, and cultural or institutional influences. Furthermore, quantitative studies are needed to shed light on response patterns' generalizability and prevalence, depending on measurement and group characteristics. For example, tendencies toward homogeneity may vary depending on group type, and agreement strategies may vary depending on group size.

5. Outlook

This contribution has contextualized, introduced, and tested the practical applicability of a novel standardized online group survey approach tailored for groups. In the first step, it was demonstrated that the group survey approach can meaningfully complement existing methodological approaches to group-level measurements. The second step specified how a group survey addresses groups while also accounting for potentially divergent responses between individual members. The approach's key benefits are that it simultaneously accounts for the group level of analysis, captures within-group heterogeneity and unobservable group constructs, and can be applied to many groups efficiently. Its central limitations include recruitment challenges and reactivity. In the third step, it was demonstrated empirically that the group survey is also practically applicable, as it can be completed independently and represents the whole group.

After the conceptual and exploratory groundwork for the group survey approach has been laid out in this contribution, the next necessary step is to validate the approach. In the consensus method's context (as introduced above), the principle of standardized group responses has already been validated. Gibson et al. (2000) demonstrated the discriminant and convergent validity of different measures of group efficacy via the consensus method. Furthermore, several studies have tested the predictive validity of different constructs measured by the consensus method (group efficacy: Gibson et al., 2000; team effectiveness: Kirkman et al., 2001; team cohesion: Quigley et al., 2007). They consistently demonstrated that group responses outperform methods aggregating individual survey responses in predicting associated outcomes, such as group performance (Gibson et al., 2000; Kirkman et al., 2001; Quigley et al., 2007). In line with the conceptual argument made throughout this paper, these empirical results emphasize the necessity and utility of a standardized self-report approach that genuinely addresses the group level.

However, two notable distinctions exist between the consensus method and the group survey approach. First, the consensus method typically involves single questions in the laboratory, while the group survey approach builds on an entire online questionnaire for groups. Second, the consensus method obligates groups to reach agreement on shared responses, while the group survey method offers a disagreement option. Thus, future studies need to validate the group survey approach in particular. Comparing measures of the same constructs' measures with

different methodological approaches would shed light on their convergent validity. For example, group survey measures could be compared with standardized observations of specific collective behaviors, such as media selection and use. Another approach would be to triangulate standardized group responses with qualitative data on the same group phenomena to gain a deeper understanding of the group survey's capabilities and blind spots (see Schindler, 2023, for initial attempts). Observational approaches, including ethnographic methods and individual and group interviews, can be used in this context. Furthermore, testing the relationships of different constructs measured through a group survey would help assess their discriminant and nomological validity (see Schindler, 2023, for related analyses). For example, to assess their nomological validity, it could be tested whether group surveys can replicate relationships between constructs known from previous group research. Such relationships could be the ones between attitude diversity or group norms and group polarization (Strandberg et al., 2019). These efforts also automatically would involve development of group-level scales, facilitating further group research.

Further methodological studies could examine the relationship between individual and group responses, particularly concerning individual members' satisfaction with group outcomes. Furthermore, future studies could investigate the potential of group surveys conducted via video chat, with various group sizes, and with subgroups representing larger groups. So far, the group survey approach cannot meet individual-level surveys and scales' standards, which countless researchers have refined for decades. Nevertheless, it should have been demonstrated that establishing group surveys further would be a worthwhile endeavor. The group survey approach facilitates experiments, longitudinal studies, and multilevel analyses with natural groups. By enabling more rigorous, generalizable, and diverse group research, it holds potential for all research fields involving collective perception, thinking, feeling, and action. It could also be particularly valuable for testing and developing group-level theories, which in turn would advance empirical research further. Thus, continuing the journey toward a standardized group survey approach would open important new possibilities for studying group dynamics across various communication contexts.

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Declaration of interest

There is no conflict of interest to disclose.

Data availability statement

The data underlying this article cannot be shared publicly for the privacy of individuals who participated in the qualitative interview study. The data will be shared on reasonable request to the author.

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Appendix

Appendix 1. Group questionnaire (translated from German)

Supplemental Material

Toward a Standardized Group Survey
Introducing a New Approach to Group-Level Measurements in Communication Studies

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Group Questionnaire

(Translated from German)

[page: 2]

At the beginning, please set a separate name for each of you that you can remember easily and not get mixed up.
This information is stored together with your other answers. If you do not want to use your first name, you can use nicknames or numbers, for example.
[Open text box for each group member]

[page: 3]

As mentioned at the beginning, we would like to invite each of you to a short individual follow-up survey. For this purpose, we ask you for your e-mail addresses and your consent that these will be stored until the completion of the follow-up survey.

You can withdraw this consent at any time. Your e-mail address will be stored separately, won't be given to third parties, and will be deleted after the invitation to the follow-up survey. The information you provide in this survey will remain anonymous.

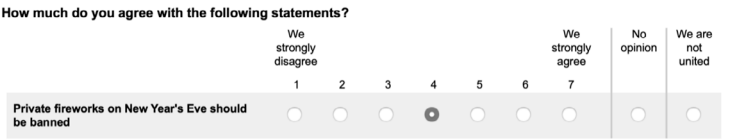
More information on data protection
[Info box to open]

[For each group member]
E-mail address of **[name]**: *[Open text box]*
[Opt-In] I agree that my e-mail address will be used for the purpose stated above only.

[page: 4]

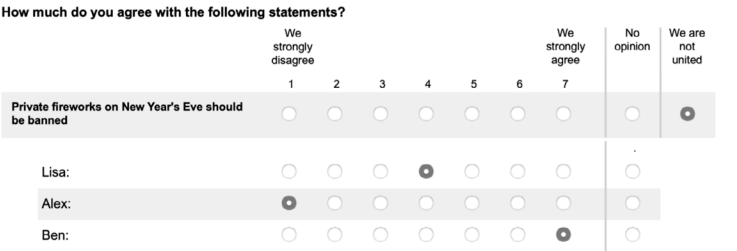
The following questions address you as a group. If you share one opinion, please always select the position that most closely matches your shared answer, as in example 1.

Example 1:



If you have different opinions, you can select "We are not united" as in example 2. For some of the questions, then, extra answer options will be displayed for each of you.

Example 2:



[page: 5]

[measure: attitude before the stimulus]

How much do you agree with the following statements?
Cities should be car-free.
Cities can function well without cars.
// Same-sex couples should be allowed to have children.
// Same-sex parents can give children everything they need.
[Scale] (1) We strongly disagree - (7) We strongly agree
No opinion
We are not united
[If not united: Display of answer options for each group member individually]

[page: 6]

[measure: perceived opinion deviation]

And how much do you think *most people in Germany* agree with these statements?
Cities should be car-free
Cities can function well without cars.
// Same-sex couples should be allowed to have children.
// Same-sex parents can give children everything they need.
[Scale] (1) Strongly disagree - (7) Strongly agree
We don't know
We are not united
[If not united: Display of answer options for each group member individually]

[page: 7]

[measure: issue involvement before the stimulus]

How important is your position on "car-free city" // "same-sex parenting" to you?
This is about how *important* your position is to you, not what position it is. For example, if it is very important to you that cities are car-free // same-sex couples are allowed to have children, please select 7. If it is very important to you that cities are not car-free // same-sex couples are not allowed to have children, please also select 7.
To us, our position is…
[Skala] (1) Not important at all - (7) Very important
We are not united
[If not united: Display of answer options for each group member individually]

[page: 8]

[measure: knowledge]

In the following, we would like to ask you to participate in a small quiz on "car-free cities" // "same-sex parenting". Please collectively select the answer option that seems correct to you. There is always only **one correct answer.**

It is perfectly normal if you cannot answer one or more questions. Please do not try to look up the answers on the Internet. At the end of the questionnaire, you will see the solutions.

You have 30 seconds for each question and will then be automatically redirected. Please do not use your browser's back button, as this will end the survey.

What does the term "mobility transition" mean? • The banning of all diesel vehicles • A complete shift to computer-controlled, "intelligent" means of transport. • The changes in traffic in eastern Germany after German reunification. • A fundamental shift towards environmentally friendly transportation. *[correct]* • We do not know. • We are not united.	• **What option do same-sex couples in Germany <u>not</u> have to become parents?** • Adopting a child. • Fostering a child. • Using a sperm donation. • Commissioning a surrogate mother. *[correct]* • We do not know. • We are not united.
Which transportation means requires the most energy per person and per km? • Train • Bus • Car *[correct]* • Metro • We do not know. • We are not united.	• **Since when can gays and lesbians marry in Germany ("marriage for all")?** • Since 2001 • Since 2015 • Since 2017 *[correct]* • Not at all, they are only allowed to enter into a registered civil partnership until today. • We do not know. • We are not united.
Which is <u>not</u> among the suggestions for environmentally friendly transport? • Moving all road traffic into tunnels. *[correct]* • Linking different forms of mobility such as public transport, car, and bicycle traffic. • Transporting goods by train or ship. • Sharing mobility. • We do not know. • We are not united.	• **Which of the following rights have been newly granted to same-sex couples by "marriage for all" in Germany?** • They can adopt children as a married couple *[correct]* • They can adopt a common surname. • They can register a different gender when they marry. • None of these rights. • We do not know. • We are not united.

Who is the current federal minister of transport in Germany?
- Heiko Maas (SPD)
- Andreas Scheuer (CSU) *[richtig]*
- Jens Spahn (CDU)
- Peter Altmaier (CDU)
- We do not know.
- We are not united.

- **Which party is particularly critical of marriage for same-sex couples?**
- CSU *[correct]*
- Die Linke
- FDP
- All three parties oppose same-sex marriage.
- We do not know.
- We are not united.

[page: 9]

Next, we would like to show you a five-minute video clip on "car-free cities"// same-sex parenting". Please turn on your speakers for this.
Just watch the video together as you would in your everyday life, for example, when you watch TV together. Feel free to use the full-screen mode of the video, which you can exit by pressing the ESC key.

[video stimulus on* "car-free cities"// same-sex parenting"*]

[page: 10]

Now we would like to ask you to talk a little bit more about the video and the topic "car-free cities"// same-sex parenting".
There is no "right" or "wrong" here. Just talk spontaneously about what interests you as you would in your everyday life. After two minutes, the "continue" button will reappear, but feel free to take more time as needed.

[page: 11]

[measure: arguments / systematicness and openness (open)]

Now please list concisely and understandably each point you have just talked about. Use a new text window for each point.
It doesn't matter whether these points were related to the topic "car-free cities" // "same-sex parenting" or not. It's about what you were really talking about. After two minutes, the "continue" button will reappear, but feel free to take more time as needed.
[Open text box for up to 12 points]

[page: 12]

You can see all the points you have just listed from your conversation here. Now, for each of these points, indicate whether you think it speaks more against or more in favor of car-free cities // same-sex parenting. If the point is not relevant to this topic from your perspective, you can also indicate that.
[Selection for each of the points entered]
Rather against
Undecided
Rather in favor
Not relevant
Not united

Do all of you agree with these points and your classification?
[Selection]
Yes
No

[page: 13]

[measures:
systematicness (standardized, 1-4, 11)
openness (standardized, 5-10, 11)
affects (during processing, 12-14)
collaboration patterns (15-18)]

The next questions are also about your conversation after the video.

How much do the following statements apply to your conversation?
Again, there is no "right" or "wrong", but we are interested in your natural conversation.
1. We have discussed extensively.
2. We discussed some aspects in particular depth.
3. Certain points were particularly important to us in the conversation.
4. We had little need to talk. (reversed)
5. We almost always agreed in our conversation. (reversed)
6. We repeatedly had different opinions and discussed them.
7. We mainly talked about points that support our opinion. (reversed)
8. We exchanged arguments for one side as well as for the other.
9. Each of us already knew most of the things we talked about. (reversed)

[Scale] (1) We strongly disagree - (7) We strongly agree
No opinion
We are not united

[page: 14]

And how much do the following statements apply to your conversation after the video?
10. We learned many new things through the conversation.
11. We developed new ideas together in the conversation.
12. Each of us contributed equally to the conversation.
13. In the conversation, we oriented ourselves to a person who knows the subject well.
14. In the conversation, good arguments were brought up that convinced us.
15. *[>2 group members]* In the conversation, we oriented ourselves to the position that most of us had.
16. We lightened up the conversation with a lot of humor.
17. Our discussion was passionate.
18. Because of disagreements, the atmosphere in our conversation was sometimes tense.

[Scale] (1) We strongly disagree - (7) We strongly agree
No opinion
We are not united

[page: 15]

[measure: affects (before processing)]

The next questions are about how you watched the video together.

How much do the following statements apply to you when you watched the video?
If you perceived the video differently, you can select "We disagree" and answer individually.
1. We watched the video carefully.
2. We felt moved by the video.
3. We were annoyed by the video.
4. We made jokes about the video.

[Scale] (1) Strongly disagree - (7) Strongly agree
No opinion
We are not united
[If not united: Display of answer options for each group member individually]

[page: 16]

[measure: evaluation of the stimulus]

Now please tell us what you thought of the video.
The video was...
[Skala] (1) Poorly done - (7) Well done
We are not united
[If not united: Display of answer options for each group member individually]

[page: 17]

[measure: stimulus recall]

Before we get to the final questions, we would like you to share a brief summary of the video (about 250 characters).
Imagine telling someone else about the video in two sentences. After one minute, the "continue" button will reappear, but feel free to take more time as needed.
[Open text box showing the current number of characters with a limit of 300]

Do all of you agree with this summary?
[Selection]
Yes
No

[page: 18]

[measure: attitude after the stimulus]

Now we are interested in your opinion again.

How much do you agree with the following statements?
Cities should be car-free
Cities can function well without cars.
// Same-sex couples should be allowed to have children.
// Same-sex parents can give children everything they need.
[Scale] (1) We strongly disagree - (7) We strongly agree
No opinion
We are not united
[If not united: Display of answer options for each group member individually]

[page: 19]

[measure: issue involvement after the stimulus]

How important is your position on "car-free city" // "same-sex parenting" to you?
This is about how *important* your position is to you, not what position it is. For example, if it is very important to you that cities are car-free // same-sex couples are allowed to have children, please select 7. If it is very important to you that cities are not car-free // same-sex couples are not allowed to have children, please also select 7.
To us, our position is…
[Skala] (1) Not important at all - (7) Very important
We are not united
[If not united: Display of answer options for each group member individually]

SCM
Studies in Communication and Media

FULL PAPER

Public versus individual autonomous mobility and the reference to science in the news media: Frames of risks, benefits, and governance in Germany from 2018 to early 2023

Die Berichterstattung über autonome Mobilität im öffentlichen Nahverkehr vs. Individualverkehr im Kontext von Wissenschaft: Das Framing von Risiken, Chancen, und Governance in Deutschland von 2018 bis Anfang 2023

Andreas Schwarz & Tatjana Faj

Andreas Schwarz (Priv.-Doz. Dr. habil.), Technische Universität Ilmenau, Institute of Media and Communication Science, Ehrenbergstraße 29, 98693 Ilmenau, Germany. Contact: andreas.schwarz@tu-ilmenau.de. ORCID: https://orcid.org/0000-0001-9033-9662
Tatjana Faj (M.A.), Technische Universität Ilmenau, Institute of Media and Communication Science, Ehrenbergstraße 29, 98693 Ilmenau, Germany. Contact: t.faj@gmx.de

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Abstract: Recently, autonomous driving has received significant attention in risk and science communication research due to its increasing public visibility. However, media research has not differentiated between individual autonomous mobility (IAM) and autonomous public transport (APT), although autonomous and/or automated buses are being tested on the roads of many European municipalities. The reference to science in the media discourse has not been a major focus. Therefore, we analyzed regional and national German news media from 2018 to early 2023 using quantitative content analysis. The findings revealed three frames: Neutral traffic/business stories, safety and governance concerns, and benefits of science and technology. APT was framed more positively, while IAM was more often framed in terms of risk/safety concerns. References to science were scarce, with implications for science communication and reporting.

Keywords: Autonomous driving, autonomous mobility, science communication, framing, public transport

Zusammenfassung: In den letzten Jahren wurde Technologien autonomer Mobilität aufgrund ihrer zunehmenden öffentlichen Sichtbarkeit mehr Aufmerksamkeit in der Risiko- und Wissenschaftskommunikationsforschung zuteil. Allerdings mangelt es in der Medienforschung hier bislang an Unterscheidungen zwischen autonomer individueller Mobilität und dem autonomen öffentlichen Nahverkehr, obwohl autonome bzw. automatisierte Busse in zahlreichen europäischen Gemeinden auf den Straßen getestet werden. Auch der Bezug zur Wissenschaft im Mediendiskurs stand nicht im Mittelpunkt. Daher wurden im Rahmen dieser Studie regionale und überregionale Nachrichtenmedien von 2018 bis Anfang 2023 mithilfe einer quantitativen Inhaltsanalyse untersucht. Die Ergebnisse ergaben drei übergreifende Frames: (1) neutrale Storys über Verkehr und Wirtschaft, (2) Sicherheits- und Governance-Bedenken sowie (3) Vorteile von Wissenschaft und Technologie. Der **öffentliche** Nahverkehr wurde eher positiv dargestellt, während **über** individuelle autonome Mobilität häufiger im Zusammenhang mit Risiko-/Sicherheitsbedenken berichtet wurde. Verweise auf

wissenschaftliche Forschung waren selten. Daraus folgen Implikationen **für** Wissenschaftskommunikation und -journalismus, die im Beitrag besprochen werden.

Schlüsselwörter: Autonomes Fahren, autonome Mobilität, Wissenschaftskommunikation, Framing, ÖPNV

1. Introduction

The public opinion about science and technology is highly influenced by their portrayal in the news media, which may impact funding, political support, career opportunities, science literacy, and trust in science (Nisbet et al., 2002; Schäfer, 2017). News media appear to be an important driver of individuals' risk perceptions of emerging technologies, particularly when personal experience with the risk is lacking (Renn & Benighaus, 2013). Therefore, both science communication and risk communication researchers have repeatedly analyzed news media content to identify representations of risks, benefits, governance issues, and the way science sources are used to shape emerging technologies such as biotechnology, nanotechnology, or artificial intelligence (AI) (e.g., Donk et al., 2011; Marks et al., 2007; Nguyen & Hekman, 2022). Mediated science communication is considered to play a crucial role in the intersection of science and society, in particular for emerging sciences that confront society with uncertain risks and requirements of regulation (Scheufele, 2022).

Among these emerging sciences, AI and automation have an increasing impact on public discourse and research. In particular, autonomous mobility has been ascribed an influential role in public perception and acceptance of AI applications, as "[t]ransportation is likely to be one of the first domains in which the general public will be asked to trust the reliability and safety of an AI system for a critical task" (Stone et al., 2016, p. 18). Ongoing tests of self-driving cars by major tech companies, as well as pilot projects of automated public transport, increasingly generate first-hand experiences with the technology and media coverage. A few studies have shown significant influence of the mass media on benefit and risk perceptions as well as the willingness to ride autonomous vehicles (Anania et al., 2018; Zhu et al., 2020). Nevertheless, the authors of two recent studies in Germany and the US noted the lack of research on the media's portrayal of autonomous driving (Jelinski et al., 2021; Penmetsa et al., 2023). Like political regulation and governance of autonomous mobility, research on mediated science and technology communication struggles to keep up with the rapid pace of technological development. Consequently, this study aims to examine how the news media have framed autonomous mobility and the role of science in recent years.

With the adoption of the Automated Driving Act in 2021, Germany can be considered a leading country in the field, as the regulation represents the first comprehensive national law on autonomous driving (Kriebitz et al., 2022). In addition, we have identified more than sixty partly publicly funded projects in German municipalities where automated buses have been and are being tested in public transport. This not only allows the local media to cover specific projects in their region but also makes the technology more tangible to the public (Appel et

al., 2020). Most of these projects of autonomous/automated public transport (APT) have started after 2017 and were therefore not covered by previous media research on autonomous driving in Germany (Jelinski, 2021; Taddicken et al., 2020). Hence, this research was largely limited to news portrayals of the general technology or applications of individual autonomous mobility (i.e., the development, promotion, and use of autonomous vehicles for private use). Because many of the municipal APT projects included funding for partners at public universities to conduct research on various aspects of the technology during operation, as well as research on public acceptance (Riener et al., 2020), our goal was to identify media frames of APT and compare them to the coverage of individual autonomous/automated mobility (IAM). For IAM, previous research found a dominance of business frames as opposed to science frames or sources. Hence, from a science communication perspective, it is relevant to discern whether publicly funded APT projects with explicit involvement of science and science communication practitioners successfully stimulate news media frames with more pronounced references to science and scientific sources. This is of particular interest as public transport, APT, and APT-related research are highly subsidized in Germany, whereas IAM has largely moved to the business domain. As APT applications increasingly depend on public support, which in Germany remains limited in terms of autonomous mobility (KPMG, 2020; TÜV-Verband, 2021), the news media's framing of APT plays a crucial role.

2. Media coverage of autonomous mobility and its influence on public perceptions

General attitudes towards autonomous mobility in Germany appear to be somewhat ambivalent (KPMG, 2020). Surveys have shown that about half of the population would not consider using driverless vehicles, with younger Germans (18–34) being less skeptical (Bratzel, 2022). People's most prevalent concerns were general safety issues, cyberattacks, accidents, and costs. In a TÜV survey (2021), one-third of the respondents said they would not drive fully automated vehicles once they were allowed to circulate on German roads. Germans have a very low tolerance for accidents caused by autonomous vehicles, with only 4% accepting driving errors comparable to human drivers. Predictors of behavioral intentions to use automated vehicles are, for example, performance expectancy, effort expectancy, trust in driverless cars, hedonic motivation, risk perception, and social influence (e.g., Jing et al., 2020; Kaur & Rampersad, 2018; Nordhoff et al., 2021) according to international research. Few studies have focused on attitudes towards automated public transport (e.g., shuttle buses) in regional pilot projects in Germany or elsewhere. They often found rather positive attitudes among the local population (Beckmann and Zadek, 2022; Kostorz et al., 2019; Rauh et al., 2020). Perceived benefits were related to improved mobility for the elderly or disabled and environmental protection. Concerns were related to the risk of accidents, interaction problems with other road users, and data security. Qualitative research in Singapore has shown that parents, for example, are con-

cerned about technical risks, AI systems, cybersecurity, or harassment related to their children using APT (Ho & Tan, 2023).

Media coverage of autonomous mobility was found to influence the public's perception of the technology. Fraedrich and Lenz (2016) investigated user comments on German and US news articles dealing with the Google Driverless Cars Road approval in California in 2012. Users attributed positive (e.g., safety advantage, more flexibility) and negative characteristics and consequences (e.g., loss of jobs) to autonomous vehicles. The general evaluation of the technology was ambivalent to negative. A survey of Chinese students showed that information about autonomous vehicles is much more frequently retrieved from mass media than social media (Zhu et al., 2020). Mass media use had a positive influence on self-efficacy, risk perception, perceived usefulness, and behavioral intentions. Anania et al. (2018) found that exposure to positive headlines on the subject leads to a higher willingness to use a driverless car than exposure to negative headlines. Attention to news about autonomous vehicles was found to negatively affect excitement and positively predicts anxiety as well as subjective knowledge about autonomous mobility (Myrick et al., 2019).

Although these findings demonstrate the relevance of news media coverage of autonomous mobility for public acceptance, risk perceptions, and behavioral dispositions, only a few studies analyzed the media coverage of autonomous mobility. Taddicken et al. (2020) analyzed German newspaper articles between 2014 and 2017. Four frames emerged from their cluster analysis. In the first frame, autonomous driving was depicted as technological progress with both positive evaluations and prognoses for the future. The second frame was more ambivalent and covered both benefits and risks in more balanced and longer articles. The third frame was more negative, dealing mainly with demands for political regulation. The fourth frame emphasized the benefits of autonomous driving for the economy. Scientific actors were rarely mentioned in comparison to business actors or the technology itself (Taddicken et al., 2020).

Jelinski et al. (2021) examined articles on autonomous driving in German online newspapers from 2017 to 2018. The authors found that most of the articles had a rather neutral tonality with a tendency towards more optimistic arguments with a low level of detail. The articles that were not neutral revealed a discrepancy between the negative headlines and the rather positive article content. The resulting assumption was that readers who only notice the headlines will get a more negative impression, and those who read the entire article will get a more positive impression of autonomous driving.

Using sentiment analysis, Penmetsa et al. (2023) investigated over 1.7 million news articles between 2016 and 2022 in the US. The highest number of articles dealing with autonomous driving was found in 2018, with significant spikes in negativity compared to the other years. The authors attributed this to several accidents in the US involving self-driving vehicles. They concluded that negative events like accidents or catastrophes can lead to media bias regarding autonomous mobility. Such events can be trigger events for processes of social risk amplification as conceptualized in the social amplification of risk framework (SARF) (Kasperson et al., 1988; Kasperson et al., 2022). From this perspective, technolo-

gical risk events lead to information flows and communication processes through various social stations, including social media and the news media, and, therefore, amplify public risk perceptions. Passing a certain threshold, this process may cause further changes in attitudes and behavior (individual level) or political and social action, as well as changes in risk governance (societal level).

Our literature review shows that findings on media coverage of autonomous mobility are only available until 2018 (Germany) or are limited to sentiment data. In addition, experts have pointed out that while Germany is a leader in autonomous mobility innovation and technology, it lags behind in terms of consumer acceptance (KPMG, 2020). Understanding the dominant news media frames of technology in the country is therefore relevant to explaining this gap from both an aggregate (i.e., frames) and a diachronic perspective (i.e., frame development over time). As a result, our first research question was *How did national and regional news media in Germany frame autonomous mobility from 2018 to early 2023* (RQ1)*?*

Previous media research has not addressed APT as a specific topic or distinguished it from IAM, although a high number of publicly funded APT projects were realized in Germany after 2017 with a significant involvement of scientific actors. These projects have successfully moved autonomous vehicles from closed to public municipal spaces and are considered an important driver of innovation and public acceptance (KPMG, 2020). However, research on APT projects has been limited to surveys of local populations and found that APT was mostly perceived as positive, with some concerns about safety and traffic obstructions (Beckmann & Zadek, 2022; Kostorz et al., 2019; Rauh et al., 2020). Based on the lack of news media research on APT, we posed our second research question: *How did the national and regional news media in Germany frame APT in comparison to IAM (RQ2)?*

Public transportation in this context refers to non-rail and land-based passenger transportation available to the public, which was the most common in the aforementioned projects. In addition, local bus services and short-distance transit are the most important transportation modes in Germany, with approximately five billion passengers in 2023 (Statistisches Bundesamt, 2025).

3. The role of science in the media coverage of emerging technologies

Media research on emerging technologies is extensive and includes, for example, biotechnology (Marks et al., 2007; Matthes & Kohring, 2008), nanotechnology (Donk et al., 2011; Metag & Marcinkowski, 2014), and artificial intelligence (AI) (Cools et al., 2022; Nguyen & Hekman, 2022). Most of this research has used different versions of the framing concept. Since a complete review is beyond the scope of this article, we summarize major findings that exemplify tendencies in the media coverage of emerging technologies and the way science is framed.

German, Swiss and Austrian quality newspapers, for instance, were found to evaluate nanotechnology positively in the early 2000s, focusing mainly on the benefits for medicine, science, and the economy (Metag & Marcinkowski, 2014). Most of the media coverage was published in science sections, and science journa-

lists were an important source of critical judgments. Studying the framing of biotechnology in the US, Matthes and Kohring (2008) identified three frames, one labeled as 'research benefit', in which scientists outline benefits for research on biomedicine and health, whereas risks were not discussed. Cools et al. (2022) analyzed news articles in the US between 1985 and 2020 on AI/automation and identified a balanced number of positive and negative frames. Concerning science, a positive frame, labeled 'gate to heaven', appeared frequently, presenting AI as a holy grail with very beneficial impact on human lives. A neutral frame with references to science was the 'uncertainty' frame, in which AI and automation were presented as complex and inscrutable technological systems or processes. A negative frame that appeared frequently with the topic of science was 'shortcoming', in which AI shortcomings were emphasized together with the need for human supervision (Cools et al., 2022).

In summary, media research on science and technology often found positive tendencies in the media coverage with more emphasis on benefits than on risks. The media content tended to feature business and politics more prominently than science and scientists, depending on the specific technology being examined. As shown before, the media coverage of autonomous mobility also rarely refers to science or scientific institutions. While this finding may be because IAM is mainly developed and promoted by business actors, the nature of publicly funded APT projects in Germany and their explicit involvement of public universities and science communicators raises the question of whether science plays a more prominent role in the coverage of APT. Hence, our third research question was: *To what extent did German national and regional news media refer to science topics and sources across frames when reporting about IAM in comparison to APT (RQ3)?*

4. Approach to detecting media frames of autonomous mobility

In general, framing is considered a powerful mechanism in (mediated) science communication, especially in the context of ambiguous stimuli such as emerging technologies, when audiences are required to make judgments about the risks or regulatory policies to manage the risks associated with these technologies (Scheufele, 2013). The field of media framing research was characterized by a vast variety of conceptual and operational approaches (de Vreese, 2012; Guenther et al., 2023). At the conceptual level, issue-specific frames are distinguished from generic frames. Issue-specific frames refer to specific topics or events, whereas generic frames can be identified independently from specific themes over space, time, and cultural contexts (de Vreese, 2012). Since our goal was to identify frames specifically used to report on autonomous mobility and compare them to previous research with similar approaches, an issues-specific approach was more feasible.

At the *operational level*, many approaches to frame measurement exist (Matthes & Kohring, 2008). A simplified distinction often refers to inductive and deductive approaches to frame detection. Inductive methods involve frames emerging from the data, allowing for the possibility of discovering new frames. On the other hand, deductive approaches rely on predefined frames and code for their

presence or absence in the material (Iyengar, 1991; Semetko & Valkenburg, 2000). Due to the scarce media research on autonomous mobility and the lack of reference to APT, a list of predefined frames was not available. Therefore, an inductive variable-based approach to framing was used.

A widely adopted conceptual framework that is well-developed at the operational level, is Entman's (1993) frame definition according to which journalists frame certain subjects by selecting "some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation" (p. 52). Using this definition, Matthes and Kohring (2008) developed an operational approach that employs several indicators at the variable level to measure the four frame elements of problem definition, causal interpretation, moral evaluation, and treatment recommendation. Problem definitions consist of an issue (i.e., topics) and relevant actors. Causal interpretation is measured by attributions of failure or success regarding a specific issue. This refers, for instance, to the attribution of risks/benefits by specific senders to those responsible for risks/benefits. Moral evaluations were understood as positive/neutral/negative evaluations of different objects, while treatment recommendations were defined as calls for or against a certain action (Matthes & Kohring, 2008). Each frame element was measured by several variables, which subsequently were used to identify systematic groupings of texts (i.e., frames) using cluster analysis.

With this approach, we analyzed media reports about autonomous mobility according to (a) the main topics, risks and benefits, beneficiary and damaged actors (problem definition); (b) attributions of responsibility for risks and benefits of autonomous mobility *by* and *to* these actors (causal interpretation); (c) evaluations of autonomous mobility in general (moral evaluation); (d) and calls for actions to deal with the issue (treatment recommendation). Thus, for each of the four frame elements, we developed measures for content analysis that were adopted from previous framing research (Donk et al., 2011; Matthes & Kohring, 2008), mainly from the study of Taddicken et al. (2020) on autonomous mobility for reasons of comparability. Some adjustments were made to capture the particularities of APT as well as more differentiated measures of risks and benefits based on our literature review. Science was included as source/actor or topic in all frame elements except moral evaluation.

These indicators were subsequently used in several cluster analyses to detect statistically recurring patterns in the media coverage (i.e., frames). This method of frame detection that has been shown to be valid and reliable compared to alternative approaches and was frequently used to analyze science and technology reporting (e.g., Donk et al., 2011; Matthes & Kohring, 2008; Schwarz & Seidl, 2023; Taddicken et al., 2020).

5. Method

5.1 Sample

We included the nationally circulated newspapers and online magazines *Frankfurter Rundschau*, *Spiegel Online*, *TAZ*, *Welt*, and *ZEIT*. These are among the most influential and widely circulated news media outlets in Germany. As in Taddicken et al. (2020), we included the regional press at the automotive hub of Stuttgart, where companies such as Daimler, Porsche and Bosch are based. To extend the scope of this study compared to previous research and to include media coverage of regional pilot projects in APT, we added between one and three regional newspapers (depending on availability) with the highest circulation in the federal states where such projects were carried out between 2018 and 2023. Most articles were retrieved from Nexis. In some cases, articles were directly retrieved from the newspapers' websites since they were not available otherwise (see Table 1).

Table 1. Sample of regional and national news media outlets and exemplary pilot projects of automated public transport by state

State/region	News media outlets	*n*	Exemplary regional project of automated public transport and project websites
Baden-Württemberg	*Stuttgarter Nachrichten* *Stuttgarter Zeitung*	36 27	U-Shift MAD *https://verkehrsforschung.dlr.de/de/projekte/u-shift/u-shift-mad (website inactive)*
Bayern	*Passauer Neue Presse*	39	HEAL Bad Birnbach *https://heal-badbirnbach.de*
Berlin	*Tagesspiegel* *Berliner Zeitung* *Berliner Kurier*	29 17 4	First Mover *https://www.emo-berlin.de/aktuelles/detail-projekte/first-mover (website inactive)*
Hamburg	*Hamburger Morgenpost*	15	HEAT *https://www.hochbahn.de/en/projects/the-heat-project*
Hessen	*Frankfurter Rundschau** *Frankfurter Neue Presse*	8 16	Mainkai-Shuttle *https://www.probefahrt-zukunft.de/index%20-%20Frankfurt.html*
Niedersachsen	*Nordwest-Zeitung*	28	HubChain *https://www.ikem.de/projekt/hubchain/*
Nordrhein-Westfalen	*Rheinische Post* *Aachener Zeitung*	63 25	Monheim-Shuttle *https://www.bahnen-monheim.de/autonomer-bus/kurzportrait-der-altstadtstromer*
Rheinland-Pfalz	*Allgemeine Zeitung*	19	Hambach-Shuttle *https://www.hambach-shuttle.de/ (website inactive)*
Sachsen	*Sächsische Zeitung*	8	ABSOLUT *https://absolut-projekt.de/*

Sachsen-Anhalt	*Mitteldeutsche Zeitung*	15	AS-UrbanÖPNV *https://www.urban-shuttle.ovgu.de*
Thüringen	*Thüringer Allgemeine* *Ostthüringer Zeitung* *Freies Wort/ in Südthüringen*	53 30 16	CAMIL *https://www.camil-ilmenau.de/*
National (Germany)	*Frankfurter Rundschau** *Spiegel Online* *TAZ* *Welt* *ZEIT*	8 7 16 28 4	(does not apply)

Note. * Frankfurter Rundschau is a national newspaper but also covers regional issues in the state of Hessen, so is listed twice.

Articles published between 1 January 2018 to 22 February 2023 were included. This period was chosen to capture the development in German media coverage after the latest studies' timeframe of analysis ended (Jelinski et al., 2021; Taddicken et al., 2020). In addition, most of the APT projects we identified in Germany began testing automated vehicles in public after 2017.

To ensure that only articles dealing with the topic of autonomous driving and APT were analyzed, the following search term chain was used on Nexis (translated from German):

title((autonomous! OR automated! OR self-driving! OR driverless!) I/50 (drive OR car OR bus OR shuttle OR cars OR buses OR shuttles OR public transport))

We initially found 1,246 articles. These were manually screened to retrieve relevant articles based on their headline and/or lead paragraph, resulting in 785 articles. For the final screening, we reviewed the overall content of articles. Only those with sufficient thematic relevance were included based on the following criteria: (1) The topic of autonomous mobility was mentioned in the title, lead, and/or first paragraph, and (2) the topic was a main focus in most of the article (i.e., at least 50%). If autonomous driving was only briefly mentioned, the article was excluded. After applying these criteria, a final sample of 503 articles was included for coding.

5.2 Instrument

For reasons of comparability, our codebook was mainly based on Taddicken et al. (2020) as well as previous framing research (Entman, 1993; Matthes & Kohring, 2008). For a more detailed overview of coded categories, see Table 2. In addition to formal measures, the following categories and sub-categories were added to consider the reporting on APT and to answer RQ2 and RQ3. The variable "topic category" was included to differentiate between articles that covered IAM, APT, or both. Science/research was added as an additional main topic and as one of the stakeholders benefiting from (e.g., more funding opportunities) or being adversely affected ('damaged') by the technology (e.g., public criticism).

The indicator "future prospects" was excluded from the framing analysis since it does not really reflect a treatment recommendation and rarely occurred in the sample (<30%). We also excluded the mentioned "level of automation" from the frame detection procedure, as it does not really reflect the frame element problem definition and was often not addressed in our sample (46.3%).

Table 2. Operationalization of frame elements (main codebook categories)

Frame element	Main categories	Sub-categories	Gwet's AC1[d]
Problem definition	Main topic	Civil society, technology/innovation, economy, politics, environment, security, transport, science/research[a]	0.48
	Risks/problems	Lack of self-determination, lack of user competence, lack of acceptance, lack of support for people with disabilities[c], loss of the human element[c], high costs, social (professional) changes/ problems, lack of safety/limits of technology, ethical problems, data protection problems, regulatory limitations, traffic problems, disruptions due to unexpected weather or road conditions[c], problems in interaction with other road users[c]	0.88
	Benefits	Mobility and comfort, time savings and convenience, low individual costs, improved safety, economic benefits, environmental protection, low societal costs, solving traffic problems	0.81
	Damaged stakeholders	Human, company/ economy, science/research[a], politics/legislature[a]	0.88
	Beneficiary stakeholders	Human, company/ economy, science/research[a], politics/legislature[a]	0.76
Causal attribution	Stakeholders responsible for risks/problems	Human, car/ technology, company/ economy, science/research, politics/legislature	0.85
	Stakeholders responsible for benefits	Human, car/ technology, company/ economy, science/research, politics/legislature	0.81
Moral evaluation	Evaluation tendency/ acceptance	No evaluation/neutral, positive tendency/acceptance, negative tendency/lack of acceptance, balanced evaluation	0.61
Treatment recommendation	Recommendation for action/solution	Promoting individual competence, social debate/education, financial support/investment, technical development, expansion of infrastructure[a], creating a political/legal framework	0.89
	Sender of recommendation	Human/ private individual/ user, company/economy, science/research, politics/legislature	0.89
	Receiver of recommendation	Human/ private individual/user, car/technology, company/economy, science/research, politics/ legislature	0.87

Further categories (not frame element indicators)	Topic category[a]	Autonomous driving in general, autonomous public transport, both	0.79
	Initial reason for reporting[b]	Crisis/scandal, start/status/end of a (pilot) project with autonomous vehicles (test tracks, etc.), economic activities/developments, scientific development/discovery, developments in politics and legislation, event, art and entertainment	0.65
	Future prospects of the technology	None, positive, negative, uncertain, mixed[a]	0.68

Note. Most measures are based on Taddicken et al. (2020) with the following exceptions: [a]inductively added based on an initial qualitative review of the material, [b]based on the authors' previous research, [c]based on Nordhoff et al. (2019), [d]average of AC1 measures for categories listed in the third column

Based on the extensive literature analysis of Nordhoff et al. (2019), four more sub-categories were added to the list of risks as they appeared to be relevant in the context of APT: Lack of support for people with disabilities, loss of the human element, disruptions due to unexpected weather or road conditions, and problems in interaction with other road users.

Following recent best practice recommendations for content analysis research (Lacy et al., 2015) and due to well-documented limitations of other measures, we calculated Gwet's AC1 (Gwet, 2008) to determine reliability. This measure was demonstrated to be a more stable indicator of inter-rater reliability, that is, based on more realistic assumptions about coder behavior and task difficulty (Feng, 2013; Zhao et al., 2022). After intensive coder training, a final pretest of 50 articles coded by four coders resulted in a satisfactory average reliability value of 0.83 (Gwet's AC 1) for the codebook. The average reliability scores for each of the four frame elements resulted in *problem definition* = 0.84, *causal interpretation* = 0.83, *moral evaluation* = 0.61, and *treatment recommendation* = 0.88 (Table 2). While satisfactory reliability was achieved for most of the main categories, the variables used to code the articles' topic and moral evaluation must be treated with caution. Because these measures were derived from previous research (e.g., Taddicken et al., 2020), we decided to include them in the data analysis for comparability purposes.

5.3 Data analysis

Besides descriptive statistics, chi-square tests, t-tests, and analysis of variance (ANOVA) were used to explore relationships between variables. Effect sizes were reported as Cramer's V (chi-square tests), eta-squared (ANOVA), and Cohen's d (t-tests). The interpretation of effect sizes followed Cohen's (1988) recommendations. We applied two-step cluster analysis for frame detection. This technique has been reported to produce reliable and robust cluster solutions compared to other clustering methods, such as latent class analysis or hierarchical cluster analysis (Kent et al., 2014) and has been used in recent framing research in science communication (Donk et al., 2011; Schwarz & Seidl, 2023). Following Matthes and Kohring (2008), we excluded frame element indicators that occurred with a frequency of less than 5% in the sample. Cluster solutions were regarded as stable when a repea-

ted analysis yielded the same cluster solution and produced a silhouette coefficient above zero (fair cluster solution). Following the approach of Wessler et al. (2016), we first conducted a cluster analysis on all articles to detect the most salient frames in the overall coverage of autonomous mobility. This was followed by two separate cluster analyses on the subsamples of APT and IAM coverage to test whether the frames found in the overall coverage can be replicated in the subsamples, or whether differences emerge that are specific to the coverage of IAM and APT news.

Highly correlated variables that refer to underlying constructs may pose problems of multicollinearity in cluster analysis, which can lead to overweighting those underlying constructs and/or variables (Ketchen & Shook, 1996). Such issues of multicollinearity were often disregarded in previous framing research. A recommended remedy is principal component analysis (PCA) and standardization of variables. Therefore, we performed several PCAs on correlated and conceptually similar frame element indicators before entering them as standardized factor scores (Bartlett method) into the cluster analysis. The number of components were calculated with Eigenvalues > 1 as the criterion, followed by a Kaiser-Varimax rotation. The Kaiser-Meyer-Olkin measure (KMO, at least 0.5) as well as Bartlett's test for sphericity (should be significant, $p < .05$) were used to assess sampling adequacy. Factor loadings > .3 were considered substantial for interpretation (Hair et al., 2019). Some follow-up analyses were conducted using ANOVA with the cluster solution as the factor and, in some cases, binary outcome variables. ANOVA has been shown to work well in such contexts, although some of the classis statistical assumptions are not met (Glass et al., 1972).

6. Results

The 503 articles on autonomous mobility had an average length of 512 words (*SD* = 366.26). The majority was published in local/regional news media (87.5%) compared to national news media (12.5%). This finding points to the importance of regional projects or events related to autonomous mobility and their impact on the regional news media agenda. Most of the news coverage was found in the years of 2018 (28.6%) and 2019 (22.3%), and the least in 2020 (12.9%) and 2022 (14.7%). Most articles referred to IAM (58.8%), followed by APT (37.6%), or both (3.6%).

6.1 Aggregation of frame element indicators

Since many indicators of frame elements were substantially correlated, we conducted several PCA with these variables to reduce multicollinearity (Table 3). Following previous framing research using Entman's frame elements, we excluded variables that were coded with frequencies lower than 5%.

The first PCA comprised 18 indicators for risks and benefits of autonomous mobility about the frame element of problem definition. This resulted in a robust component solution (*KMO* = .80; *Bartlett's test p* < .001). Further analysis yielded empirical justification for retaining six factors, which accounted for 57.6% of the total variance. The varimax-rotated factor solution revealed six interpretable components of risks and benefits in autonomous mobility with substantial factor

loadings: Traffic/economic benefits, safety and traffic risks, regulatory and ethical risks, individual and environmental benefits, risks related to the users/drivers of autonomous vehicles, and ambivalent cost issues that refer to both low and high costs of autonomous mobility for society.

The second PCA included five indicators that measure the appearance of affected stakeholders in the news coverage. While the KMO was mediocre (.6), substantial factor loadings (> .7) and the high amount of explained variance (59.4%) justified retaining two factors. The first factor refers to beneficiary stakeholders, and the second factor refers to damaged stakeholders.

The third PCA was calculated with seven indicators for causal interpretation. Again, sampling adequacy was only mediocre (*KMO* = .6). Because of robust factor loadings and a good interpretability of the components, we retained the solution with two factors. The first factor, causes of risk, contained four entities that were mentioned as (potential) sources or causes of risk of autonomous mobility. The second factor referred to sources/causes of benefits.

The fourth PCA included treatment recommendations as well as senders and addressees of treatment recommendations (nine indicators). A robust solution (*KMO* = .69; *explained variance* = 59.3%) revealed three components. The first factor (development of technology and skills) included demands for more technological progress, the development of skills, and the expansion of infrastructure. Attributions to the industry/companies as senders and the technology itself as addressee of these demands also loaded on this factor. The second component (politics and governance) referred to political senders and demands for more legal regulation. The third factor (civil demands on the industry) entailed citizens/users as senders and the industry/companies as addressees of treatment recommendations.

Table 3. Principal component analyses (PCA) of frame element indicators

Frame element indicators	Principal components and factor loading					
	1	2	3	4	5	6
PCA1: Problem definition – Risks and benefits (*KMO* = .80, Cumulative % of variance = 57.60)						
Factor 1: Traffic/economic benefits						
Solving traffic problems	0.76					
Economic benefits	0.75					
Mobility and comfort benefits	0.67			0.20	0.24	
Factor 2: Safety and traffic risks						
Safety issues and limits of technology		**0.72**	0.25		0.22	
Disruptions due to unexpected weather or road conditions		0.66				
Problems in interaction with other road users	-0.22	**0.65**				
Traffic problems	0.40	**0.50**	0.22		0.33	
Factor 3: Regulatory and ethical risks						
Regulatory limitations			0.81			
Ethical issues			0.72		0.23	
Data protection issues		0.21	**0.64**			
Factor 4: Individual and environmental benefits						
Individual cost savings				0.78		
Time savings and secondary activities				**0.65**	0.25	
Environmental protection	0.44			0.45		0.19
Improved safety	0.28	0.35		0.36		
Factor 5: User risks						
Lack of user competence					0.78	
Lack of acceptance	0.24				0.73	
Factor 6: Ambivalent cost issues						
High overall social/economic costs						0.86
Low overall social/economic costs				0.46		0.58
PCA2: Problem definition – Affected stakeholders (*KMO* = .60, Cumulative % of variance = 59.43)						
Factor 1: Beneficiary stakeholders						
Companies/industry as beneficiary	.78					
Human as beneficiary	.73					
Science/research as beneficiary	.73					
Factor 2: Damaged stakeholders						

Human as damaged stakeholder		.81				
Companies/industry as damaged stakeholder		.76				
PCA3: Causal interpretation (*KMO* = .60, Cumulative % of variance = 46.13)						
Factor 1: Causes of risk						
Vehicle/technology as cause of the problem	.79					
Human as cause of the problem	.66					
Companies/industry as cause of the problem	.60					
Politics/legislators as cause of the problem	**.37**	.36				
Factor 2: Causes of benefits						
Vehicle/technology as cause of the benefit	.27	**.72**				
Companies/industry as cause of the benefit		.71				
Science/research as cause of the benefit		.64				
PCA4: Treatment recommendations (*KMO* = .69, Cumulative % of variance = 59.26)						
Factor 1: Development of technology and skills						
Companies/industry as sender	.80					
Demand for technological progress	**.69**	.29	.30			
Demand for individual skills development	**.62**	-.27	.25			
Technology/vehicle as addressee	.61		.44			
Demand for infrastructure expansion	**.46**	.39				
Factor 2: Politics and governance						
Demand for political/legal framework		.79				
Politics/legislator as sender	.21	**.78**				
Factor 3: Civil demands on the industry						
Human/user as sender			.88			
Companies/industry as addressee	.24		.64			

Note. Factor loadings < .20 suppressed; Bartlett's tests for all PCAs: p < .001; determinants > 0.00001

6.2 Frames of autonomous mobility (RQ1)

To detect frames in the news media, we included the PCA factor scores, the main topic (one indicator), and three binary variables for moral evaluation (positive, neutral/balanced, negative) in a two-step cluster analysis on all articles (n = 503). A robust and stable cluster solution with three clusters was calculated (*silhouette coefficient* = .4) (Table 4, Table A.1). For all indicators, significant differences were found between the three clusters (p < .01). Using ANOVA, the largest effects were found for safety and traffic risks, the mention of damaged stakeholders, causes of risks, and positive as well as balanced evaluations. For the main topic (categorical variable), a chi-square test also revealed significant differences between the clusters ($X^2(12) = 168.56$, p < .001, *Cramer's V* = .41).

Table 4. Two-step cluster analysis (BIC) with frame element indicators and follow-up ANOVA

Frame element	Frame element indicators		Cluster[a] 1 (37%)	2 (29%)	3 (34%)	Combined	ANOVA[b] (η^2)
Problem definition (risks/benefits)	Traffic/economic benefits	*M*	-0.40	0.00	**0.42**	0.00	.12**
		SD	0.69	1.10	1.03	1.00	
	Safety and traffic risks	*M*	-0.37	**0.75**	-0.23	0.00	**.23****
		SD	0.51	1.24	0.83	1.00	
	Regulatory and ethical risks	*M*	-0.22	**0.58**	-0.25	0.00	**.14****
		SD	0.56	1.48	0.59	1.00	
	Individual and environmental benefits	*M*	-0.17	0.01	**0.17**	0.00	.02*
		SD	0.53	1.05	1.28	1.00	
	User risks	*M*	-0.12	**0.41**	-0.21	0.00	.07**
		SD	0.48	1.55	0.68	1.00	
	Ambivalent cost issues	*M*	-0.22	**0.13**	**0.13**	0.00	.03**
		SD	0.45	1.17	1.22	1.00	
Problem definition (affected stakeholders)	Beneficiary stakeholders	*M*	-0.48	0.12	**0.42**	0.00	**.15****
		SD	0.49	0.97	1.19	1.00	
	Damaged stakeholders	*M*	-0.37	**0.96**	-0.41	0.00	**.37****
		SD	0.47	1.26	0.52	1.00	
Causal interpretation	Causes of risk	*M*	-0.43	**1.03**	-0.39	0.00	**.43****
		SD	0.39	1.26	0.44	1.00	
	Causes of benefits	*M*	-0.44	0.06	**0.43**	0.00	**.14****
		SD	0.48	1.00	1.20	1.00	
Moral evaluation[c]	Positive evaluation	*M*	0.03	0.15	**0.98**	0.39	**.78****
		SD	0.18	0.35	0.13	0.49	
	Negative evaluation	*M*	0.00	**0.19**	0.00	0.06	**.15****
		SD	0.00	0.40	0.00	0.23	
	Neutral/balanced evaluation	*M*	**0.97**	0.66	0.02	0.55	**.67****
		SD	0.18	0.48	0.13	0.50	
Treatment recommendation	Development of technology and skills	*M*	-0.30	**0.33**	0.05	0.00	.07**
		SD	0.30	1.35	1.06	1.00	
	Politics and governance	*M*	-0.19	**0.35**	-0.09	0.00	.05**
		SD	0.26	1.65	0.65	1.00	
	Civil demands on the industry	*M*	-0.25	**0.64**	-0.26	0.00	**.17****
		SD	0.26	1.61	0.44	1.00	

Note. The cluster solution's silhouette coefficient was 0.4. All frame element indicators are factor scores resulting from PCA (Table 3) except for the binary moral evaluation indicators. [a]Cluster 1 = Neutral traffic and business stories frame; Cluster 2 = Safety and governance concerns frame; Cluster 3 = Benefits of science and technology frame. [b]Follow-up analysis with one-way ANOVA and three-cluster solution as factor; $\eta^2 \geq .14$ are considered large effects. [c]Recoded to binary variables with 1 (evaluation present) or 0 (evaluation not present).

The first cluster (N = 186, 37%) mainly referred to traffic-related stories (31.7%), technology and innovation (28.5%), as well as business topics (22%). Articles in this cluster contained more neutral/balanced evaluations than the other two clusters. Most of the remaining frame element variables were rarely present, as indicated by the low factor scores. We termed this cluster as the frame of *neutral business and traffic stories*. Exemplary headlines included "Smart City Ilmenau: From assistance systems to autonomous driving" (Freies Wort, 05/18/2022) or "Autonomous buses will soon be in regular service in Monheim" (Rheinische Post, 03/27/2019).

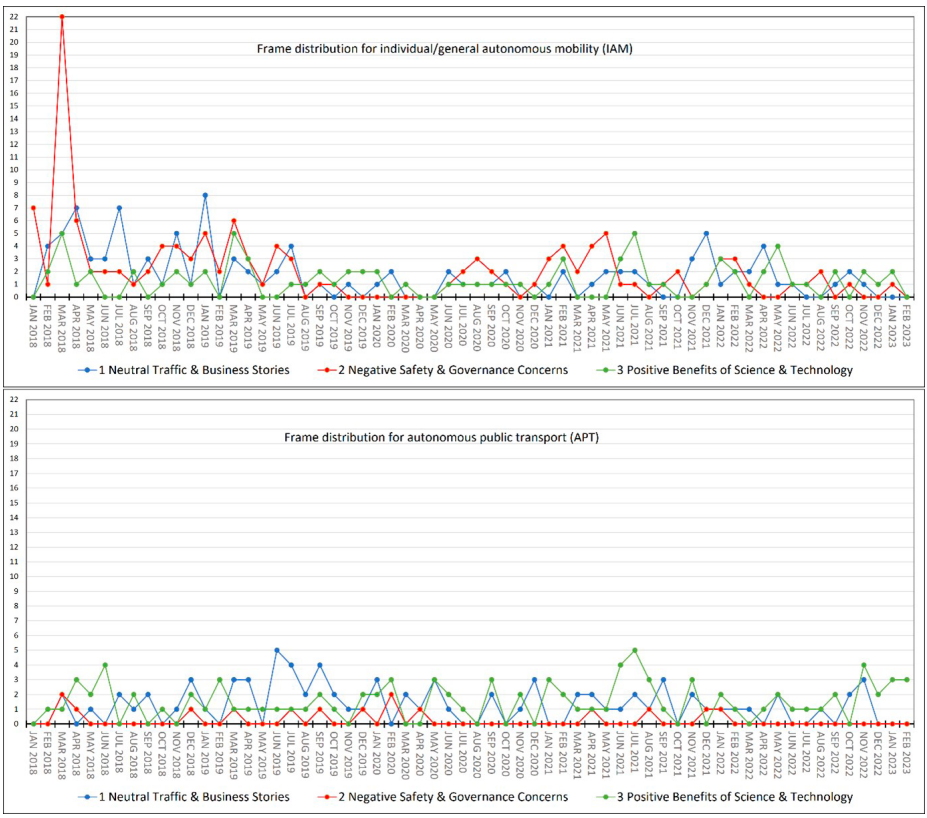
The second cluster (N = 144, 28.6%) addressed the topics of civil society (18.1%), safety issues (20.8%), and politics (7.6%) more frequently than the other frames. We found a strong emphasis on risks, especially safety and traffic risks, as well as regulatory and ethical risks. Benefits were rarely addressed. This frame emphasized damaged stakeholders over beneficiary stakeholders and mainly pointed to causes of risks instead of benefit sources. While neutral/balanced evaluations were frequent, this frame also included negative evaluations, which were largely absent from the other two frames. Treatment recommendations were salient, with demands for development of technology/skills, politics and governance, and civil demands on the industry being more emphasized than in the remaining clusters. We labeled this frame *safety and governance concerns*. Articles with that frame used headlines such as "Robot car kills woman; USA Tragic accident involving a self-driving motor vehicle" (Mitteldeutsche Zeitung, 03/20/2018) or "Robots, ethics and responsibility" (Thüringer Allgemeine, 02/12/2022).

The third cluster (= 173, 34.4%) was termed *benefits of science and technology* since the main topics were technology and innovation (50.3%), science/research (8.1%) – both more frequent within the frame than within the other frames – and business stories (20.2%). This frame mainly stressed traffic/economic benefits as well as individual and environmental benefits of autonomous mobility, while risks did not matter. Only ambivalent cost issues were found with a similar share as in the frame of safety and governance concerns. Most of the stories contained positive evaluations. Treatment recommendations were almost irrelevant, except some demands for more development of technology and individual skills. Exemplary headlines were "ZF sees Passau in first place for shuttle: Autonomous electric bus publicly presented" (Passauer Neue Presse, 05/07/2022) or "Autonomous minibuses in HVV; driverless buses to take passengers door-to-door in Hamburg's public transport from 2024 on a trial basis" (TAZ, 01/17/2023).

Over time, the media's use of the *benefits of science and technology frame* was relatively stable, with smaller peaks in July 2021, May 2022, and November 2022, for both APT and IAM coverage (Figure 1). These spikes were often related to the start or end of APT projects. The *safety and governance concerns frame* was most notably found in 2018, with a huge spike in March, exclusively for

IAM reporting. This spike was mainly the consequence of the accident of an Uber test vehicle on March 18 that killed a 50-year-old woman. The frame decreased in frequency the subsequent years and was not salient in APT reporting. *Neutral traffic and business stories* were found more often in 2018 and 2019 compared to 2020 to 2022.

Figure 1. Frequencies of news media articles on autonomous mobility for each frame over time



The comparison of national and regional/local news media outlets revealed a significant difference ($X^2(2) = 27.66$, $p < .001$, *Cramer's V* = .23), with national media focusing more often on *safety and governance concerns* (54%) than regional/local media (25%). No notable difference was found for the *benefits of science and technology frame*. *Neutral traffic and business stories* were most often found in regional/local news media (40.5%).

The initial reasons for reporting about autonomous mobility differed significantly between frames ($X^2(16) = 134.02$, $p < .001$, *Cramer's V* = .37). The frame of *safety and governance concerns* was more likely to result from crises/accidents (26.4%) compared to the other two frames (< 5%), and less likely to be used for reporting about the start of an APT project (10.4%) compared to the other two

frames (> 44%). The future prospects of the technology (not mentioned in 72.8% of the articles) were evaluated more positively in the frame of *benefits of science and technology* and more negatively in the *safety and governance concerns* frame ($X^2(8) = 66.04$, $p < .001$, *Cramer's V* = .26).

6.3 Framing APT compared to IAM (RQ2)

We split the sample in two parts: Articles with exclusive reference to APT (37.6%) and articles addressing IAM (e.g., self-driving cars) (62.4%). A comparison of the distribution of the three frames across the two sub-samples revealed significant differences ($X^2(2) = 68.34$, $p < .001$), with a moderate effect size (*Cramer's V* = .37). Articles with focus on APT were most likely to use the frames *benefits of science and technology* (49.7%) and *neutral business and traffic stories* (42.3%). *Safety and governance concerns* (7.9%) were almost irrelevant. News coverage of IAM was more likely to stress *safety and governance concerns* (41.1%) and least likely to use the *benefits of science and technology frame* (25.2%) (Table 5). This is also shown in the frame salience for IAM and APT reporting over time (Figure 1).

Table 5. Frequency of articles on general/individual and public autonomous mobility for each frame

		Frames (Clusters)			
Focus		Neutral traffic & business stories	Safety & governance concerns	Benefits of science & technology	Total
Focus on individual/ general autonomous mobility	Count	106	129	79	314
	% within Focus	33.8%	41.1%	25.2%	100.0%
	% within Frames	57.0%	89.6%	45.7%	62.4%
Focus on autonomous public transportation	Count	80	15	94	189
	% within Focus	42.3%	7.9%	49.7%	100.0%
	% within Frames	43.0%	10.4%	54.3%	37.6%
Total	Count	186	144	173	503
	% within Frames	100.0%	100.0%	100.0%	100.0%

Note. $X^2(2, N = 503) = 68.34$, $p < .001$, *Cramer's V* = .37

Following the analysis approach of Wessler et al. (2016), we conducted separate exploratory cluster analyses for the two sub-samples of IAM (n = 314) and APT (n = 189) reporting to verify if the overall frame structure can be replicated and/or whether specific differences emerge. The analysis of APT-related articles resul-

ted in a robust cluster solution of three frames (Table 6). This frame structure is similar to the overall frame structure that we found for the entire sample in that the first frame (37%) contained mostly neutral evaluations and few references to risks, benefits, or governance. The main topics were traffic and technology/innovation, which is why the frame was named *neutral traffic and technology stories*. The second frame (25%), however, contained both references to risks and benefits of automated mobility. It emphasized beneficiary stakeholders, while damaged stakeholders played only a minor role. Evaluations were ambivalent with positive, negative, and neutral stories. In terms of treatment recommendations, the development of technology and skills, as well as politics/governance measures, were emphasized. This frame is not primarily negative and not as much dominated by risk references compared to the safety and governance concerns frame of the initial cluster solution. Therefore, it was termed the *ambivalent technology and governance concerns frame*. The third frame (38%) mainly contained positive evaluations, referred to beneficiary stakeholders, and stressed traffic/economic benefits, similar to the initial cluster solution (*benefits of technology frame*).

Table 6. Two-step cluster analysis (BIC) with frame element indicators and follow-up ANOVA for articles about autonomous public transport (APT)

			Cluster[a]				
Frame element	Frame element indicators		1 (37%)	2 (25%)	3 (38%)	Combined	ANOVA[b] (η^2)
Problem definition (risks/benefits)	Traffic/economic benefits	*M*	-0.50	**0.61**	**0.61**	0.20	.26***
		SD	0.61	1.05	1.03	1.05	
	Safety and traffic risks	*M*	-0.40	**0.08**	-0.19	-0.20	.04*
		SD	0.40	1.14	1.01	0.89	
	Regulatory and ethical risks	*M*	-0.40	**-0.11**	-0.51	-0.37	.15***
		SD	0.07	0.72	0.17	0.41	
	Individual and environmental benefits	*M*	-0.27	**0.17**	-0.22	-0.14	.06**
		SD	0.37	1.19	0.64	0.76	
	User risks	*M*	-0.07	**0.14**	-0.23	-0.08	.03 n.s.
		SD	0.40	1.43	0.48	0.82	
	Ambivalent cost issues	*M*	-0.20	**0.00**	-0.20	-0.15	.02 n.s.
		SD	0.18	1.17	0.49	0.67	
Problem definition (affected stakeholders)	Beneficiary stakeholders	*M*	-0.57	**0.64**	0.36	0.08	.21***
		SD	0.39	1.19	1.24	1.12	
	Damaged stakeholders	*M*	-0.35	**-0.06**	-0.36	-0.28	.03*
		SD	0.51	0.97	0.62	0.70	

Causal interpretation	Causes of risk	*M*	-0.46	**0.14**	-0.45	-0.31	.21***
		SD	0.28	0.93	0.19	0.57	
	Causes of benefits	*M*	-0.56	**0.52**	0.06	-0.06	.21***
		SD	0.20	1.27	0.87	0.94	
Moral evaluation[c]	Positive evaluation	*M*	0.00	0.57	**0.97**	0.51	.71***
		SD	0.00	0.50	0.17	0.50	
	Negative evaluation	*M*	0.00	**0.06**	0.00	0.02	.05*
		SD	0.00	0.25	0.00	0.13	
	Neutral/balanced evaluation	*M*	1.00	0.36	0.03	0.47	.73***
		SD	0.00	0.49	0.17	0.50	
Treatment recommendation	Development of technology and skills	*M*	-0.34	**0.37**	-0.31	-0.15	.18***
		SD	0.11	1.27	0.18	0.71	
	Politics and governance	*M*	-0.18	**0.32**	-0.20	-0.07	.08***
		SD	0.27	1.50	0.10	0.79	
	Civil demands on the industry	M	-0.27	**-0.02**	-0.28	-0.21	.04*
		SD	0.05	1.14	0.09	0.58	

Note. The cluster solution's silhouette coefficient was 0.4. All frame element indicators are factor scores resulting from PCA (Table 3) except for the binary moral evaluation indicators. [a]Cluster 1 = Neutral traffic and technology stories frame; Cluster 2 = Ambivalent technology and governance concerns frame; Cluster 3 = Benefits of technology frame. [b]Follow-up analysis with one-way ANOVA and three-cluster solution as factor; $\eta^2 \geq .14$ are large effects. [c]Recoded to binary variables with 1 (evaluation present) or 0 (evaluation not present).

The cluster analysis on IAM coverage (Table 7) was less robust in comparison (*silhouette coefficien*t = 0.1) and resulted in two frames. The first frame (45%) contained both negative and positive evaluations as well as risks and benefits. However, risks, damaged stakeholders, and causes of risks were more salient than benefits, causes of benefits, or beneficiary stakeholders. Governance issues were often addressed in this frame and rarely in the second frame. Therefore, the first frame was termed *ambivalent technology, safety, and governance concerns*. The second frame (55%) only contained positive and neutral stories with an emphasis on business topics. Thus, we named it the *positive business frame*.

The comparison of these two separate cluster solutions revealed that articles on APT, compared to IAM, less often emphasize risks and more often address benefits in the according frames. In addition, APT frames rarely emphasize damaged stakeholders and more often address beneficiary stakeholders. IAM frames are either business-oriented and rather positive or, on the other hand, are very ambivalent in stressing risks and benefits of automated mobility, whereas risks, damaged stakeholders, and governance concerns outweigh the benefits.

Table 7. Two-step cluster analysis (BIC) with frame element indicators and follow-up ANOVA for articles about individual/general autonomous mobility (IAM)

Frame element	Frame element indicators		Cluster[a] 1 (45%)	2 (55%)	Combined	ANOVA[b] (η^2)
Problem definition (risks/benefits)	Traffic/economic benefits	*M*	**0.04**	-0.25	-0.12	.02**
		SD	1.15	0.74	0.95	
	Safety and traffic risks	*M*	**0.70**	-0.35	0.12	.25***
		SD	1.23	0.48	1.04	
	Regulatory and ethical risks	*M*	**0.65**	-0.12	0.22	.11***
		SD	1.49	0.64	1.17	
	Individual and environmental benefits	*M*	**0.21**	-0.02	0.08	.01 n.s.
		SD	1.31	0.90	1.11	
	User risks	*M*	**0.36**	-0.21	0.05	.07 ***
		SD	1.51	0.44	1.09	
	Ambivalent cost issues	*M*	**0.16**	0.04	0.09	.00 n.s.
		SD	1.22	1.09	1.15	
Problem definition (affected stakeholders)	Beneficiary stakeholders	*M*	0.18	-0.24	-0.05	.05***
		SD	1.07	0.73	0.92	
	Damaged stakeholders	*M*	**0.83**	-0.37	0.17	.29***
		SD	1.31	0.46	1.11	
Causal interpretation	Causes of risk	*M*	**0.88**	-0.38	0.18	.30***
		SD	1.34	0.48	1.15	
	Causes of benefits	*M*	**0.24**	-0.13	0.03	.03**
		SD	1.18	0.88	1.04	
Moral evaluation[c]	Positive evaluation	*M*	0.21	**0.41**	0.32	.05***
		SD	0.41	0.49	0.47	
	Negative evaluation	M	**0.18**	0.00	0.08	.11***
		SD	0.38	0.00	0.27	
	Neutral/balanced evaluation	*M*	**0.62**	**0.59**	0.60	.00 n.s.
		SD	0.49	0.49	0.49	
Treatment recommendation	Development of technology and skills	*M*	**0.50**	-0.24	0.09	.11***
		SD	1.52	0.45	1.13	
	Politics and governance	*M*	**0.29**	-0.16	0.04	.04***
		SD	1.58	0.33	1.11	
	Civil demands on the industry	*M*	**0.60**	-0.26	0.13	.13***
		SD	1.59	0.31	1.17	

Note. The cluster solution's silhouette coefficient was 0.1. All frame element indicators are factor scores resulting from PCA (Table 3) except for the binary moral evaluation indicators. [a]Cluster 1 = Ambivalent safety and governance concerns; Cluster 2 = Positive business frame. [b]Follow-up analysis with one-way ANOVA and three-cluster solution as factor; $\eta^2 \geq .14$ are considered large effects. [c]Recoded to binary variables with 1 (evaluation present) or 0 (evaluation not present).

In summary, the separate cluster analyses replicated the general pattern of risk versus benefit salience found in the overall cluster solution. Chi-square tests validate this as the overall cluster solution was significantly related to both the IAM frames ($X^2(2) = 226.82$, $p < .001$, *Cramer's V* = .85) and the APT frames ($X^2(2) = 190.60$, $p < .001$, *Cramer's V* = .72). However, we also found differences between APT and IAM frame structures that mainly point to higher levels of concern and more business focus in IAM, and generally more positive reporting tendencies with less emphasis on business and risks in the APT coverage.

6.4 Media references to science (RQ3)

Our findings suggest that science plays a minor role in the German news coverage of autonomous mobility. This was shown for science/research as the main topic (5%), science as a damaged stakeholder (e.g., reduction in funding, loss of credibility) (1.2%), science as beneficiary stakeholder (e.g., increase in funding for APT projects, awards) (8%), science as causing a risk/problem (e.g., lack of APT research increases safety risks) (2.4%), and science as causing a benefit (e.g., academic research increasing safety of autonomous vehicles) (5.2%). Scientific actors also played a minor role in treatment recommendations, with science rarely mentioned as a sender (e.g., scientists calling for more funding for APT infrastructure) (4.4%) or addressee (e.g., universities should do more research on security aspects of APT) (1.2%).

Regarding the detected frames, the reference to science was most prevalent in the *benefits of science and technology frame*, mainly with science as beneficiary stakeholder and cause of benefits (Table 4). Further indicators referring to science had to be excluded from the previously reported cluster analyses because of frequencies below 5%. Therefore, we conducted a follow-up ANOVA with the three frames found in the entire sample as factor (cluster solution) and the previously excluded science indicators as dependent variables. The analysis showed that science as causing a risk/problem was more likely ($F(2, 500) = 6.68$, $p = .001$, $\eta^2 = .03$) mentioned in the *safety and governance concerns frame* ($M = 0.06$, $SD = 0.24$) than in the *neutral traffic and business story frame* ($M = 0.01$, $SD = 0.07$) or the *benefits of science and technology frame* ($M = 0.01$, $SD = 0.11$). Science as sender of treatment recommendations was more likely ($F(2, 500) = 5.21$, $p = .006$, $\eta^2 = .02$) mentioned in the *safety and governance concerns frame* ($M = 0.08$, $SD = 0.28$) than in the *neutral traffic and business story frame* ($M = 0.01$, $SD = 0.10$) or the *benefits of science and technology frame* ($M = 0.05$, $SD = 0.21$).

Comparing the science indicators in APT media coverage to IAM revealed only negligible effect sizes ($\eta^2 < .02$). Science was slightly more likely to be mentioned as a beneficiary stakeholder in the APT context and more likely to be mentioned as the cause of a risk/problem or the source of treatment recommendations in the

IAM context. Science as a main topic was found more often in IAM coverage (6.7%) than in APT-focused articles (2.1%).

The differences in references to science between national and regional news media were also negligible ($\eta^2 < .02$). Science was slightly more likely to be mentioned as a damaged stakeholder and more likely to be mentioned as the cause of a benefit or the source as well as the receiver of treatment recommendations ($p < .05$) in national than in regional news. Science as a main topic was found more often in regional (5.5%) than in national news (1.6%). This difference was not significant ($X^2(6) = 8.32$, $p = .21$).

7. Discussion

The analysis revealed that most of the German news media coverage of autonomous mobility between 2018 and 2023 was positive or neutral, while a minority of articles contained negative evaluations and stressed technological or societal risks. This is in line with findings of previous research on media representations of emerging technologies such as nanotechnology (e.g., Donk et al., 2011) or AI (Garvey & Maskal, 2019), which tended to emphasize benefits over risks and/or positive over negative tone. It also confirms the results of previous media analyses in Germany on autonomous mobility (Jelinski et al., 2021; Taddicken et al., 2020).

We identified three frames (RQ1): *neutral business and traffic stories* (37%), *safety and governance concerns* (28.6%), and *benefits of science and technology* (34.4%). The *benefits of science and technology* frame was mostly positive, emphasizing the benefits of autonomous driving for mobility, the economy, and science, as well as for a range of beneficiary stakeholders. The frame has similar features as frames found in past framing research on nanotechnology (e.g., the 'research and development' frame in Donk et al. (2011)), biotechnology (e.g., the 'research benefit frame' in Mathes & Kohring (2008)), and space exploration (e.g., the 'beneficial space exploration' frame in Schwarz & Seidl (2023)). The study on autonomous mobility by Taddicken et al. (2020) found a 'technological progress' frame, which was also related to positive evaluations and innovation, but did not emphasize science very much.

The frame of *safety and governance concerns* stressed the risks of autonomous mobility, contained negative as well as positive or balanced evaluations, and addressed several required actions to control or regulate risks of the technology. This frame had similar characteristics as the 'ambivalence' frame of Donk et al. (2011) for nanotechnology or the 'SETI risk' frame for scientific space exploration (Schwarz & Seidl, 2023). Compared to Taddicken et al.'s (2020) study on autonomous mobility, this frame contained features of both the 'ambivalence' and the 'technology regulation' frame that Taddicken et al. found. Ambivalent evaluations, as well as risks and benefits, along with the need for risk governance, seem to be a recurring pattern (i.e., frame) in the media coverage of emerging technologies and science.

The frame of *neutral business and traffic stories* is the least comparable to previous research. It was mainly defined by the absence of frame indicators and

mostly addressed topics such as traffic, technology, and business. News with that frame often resulted from the start of new municipal APT projects or the release of a new product. Taddicken et al. (2020) detected a group of articles they labeled as 'short stories' that had similar characteristics as our neutral frame. The authors decided not to consider this cluster a frame. However, since the absence of certain frame elements and the focus on balanced evaluations and specific topics can be interpreted as a journalistic approach to presenting stories and concise information about events, we granted this cluster of articles the frame status.

Despite the significance of the public transportation sector in Germany (Statistisches Bundesamt, 2025) and APT being a major driver of the autonomous mobility technology and its acceptance in the country (KPMG, 2020; Rauh et al., 2020), previous media research on autonomous driving has not differentiated between individual and public transportation. This study is the first to do so (RQ2). The findings show that APT is a major topic in Germany, with more than a third of the news coverage on autonomous mobility. These news stories were frequently triggered by regional and publicly funded municipal APT projects and were mostly responsible for the positive framing of the technology. *Safety and governance concerns*, on the other hand, were much more driven by accidents and risks of IAM, such as the Uber accident in 2018, which triggered a significant amount of news coverage. This points to potential effects of IAM accidents as technological risk or trigger events that lead to mediated social risk amplification according to SARF (Kasperson et al., 2022), as we have addressed in the literature review.

The broader societal benefits of public transport (e.g., environmental benefits, advantages for elderly and disabled people) together with the fact that, so far, no major accidents have involved automated buses in Germany, seem to favor a more positive framing of the technology. Rather positive perceptions of the local population in the German municipalities where automated shuttle buses have been operated support this assumption (Kostorz et al., 2019; Rauh et al., 2020).

The presence of scientific stakeholders in the media coverage on autonomous mobility was limited (RQ3). This confirms the findings of previous media research, which indicated that the news coverage lacks scientific detail (Jelinski et al., 2021) and rarely refers to scientific actors compared to business or politics (Taddicken et al., 2020). The presence of science was much more notable in the news media's framing of other technologies, such as AI (Brantner & Saurwein, 2021) or nanotechnology (Donk et al., 2011; Metag & Marcinkowski, 2014). Journalists covering autonomous mobility seem to favor and emphasize the technology and its application as well as business-related developments, whereas scientific research is of minor interest. Although a high number of APT projects in Germany have explicitly involved publicly funded scientific institutions, their impact on media frames is limited.

7.1 Implications

Municipal APT projects and the resulting positive media coverage compared to IAM seem to be a good opportunity to narrow the gap between technology leadership and public acceptance in Germany (KPMG, 2020). Bringing automated buses to the streets of German municipalities successfully enabled citizens, but also journalists, to have direct contact with the technology and generate mostly positive personal experiences (Beckmann & Zadek, 2022; Kostorz et al., 2019; Rauh et al., 2020). At the same time, our findings suggest that individual accidents pose a substantial risk for public acceptance as they may lead to significant news media attention, at least temporarily. According to risk communication research on emerging technologies (e.g., Renn & Benighaus, 2013; Schwarz & Unselt, 2024), strict security measures and transparent communication of risks and related risk control measures are crucial in municipal APT projects.

From a science communication perspective, the active involvement of scientific partners in publicly funded APT projects is an appropriate measure to increase trust and transparency. Surveys have shown that scientists and AI engineers are more trusted than business actors and that trust in science increases support for emerging technologies (Yang et al., 2023), and/or intentions to use autonomous vehicles (Ho & Cheung, 2024). However, the scientific institutions participating in German APT projects need to professionalize their communication efforts to be better reflected as contributors in the news media, as our findings revealed few references to scientific actors or perspectives. A stronger involvement of science communicators and more emphasis on professionalized media relations in the context of APT projects can increase public support for autonomous mobility and increase subjective knowledge and insight into the scientific process of developing emerging transportation technologies. In addition to traditional techniques (e.g., press releases, press conferences), participatory formats involving local citizens (e.g., open doors, free test rides, public inauguration events with citizens and scientists, etc.) are considered effective measures (e.g., Kostorz et al., 2019; Rauh et al., 2020).

8. Limitations and future research

Future research should extend the analysis to further types of media outlets (e.g., tabloid press, local broadcasters) in Germany and/or take a cross-national comparative approach. Social media platforms (e.g., YouTube, TikTok, Instagram) are increasingly relevant in shaping perceptions and communication about emerging technologies. In future studies, topics, evaluations, and science representations on these platforms should be examined along with user comments that reflect concerns, attitudes, and trusted stakeholders in the context of autonomous mobility. In addition, municipal APT projects offer many opportunities to conduct local surveys or qualitative research to better understand the interactions between scientists, engineers, science communicators, journalists, and citizens using autonomous vehicles. In terms of theoretical implications, future research should further explore the intersections between risk communication and science communica-

tion as both are influential in understanding public perceptions, diffusion, and safety-related behavior in the context of autonomous mobility. Framing can serve as a useful approach to bridge the two fields (Scheufele, 2013; Schwarz & Unselt, 2024).

9. Conclusion

In their report on autonomous mobility in 2017, the ethics commission of the German government concluded that "[t]he public has a right to receive sufficiently differentiated information about new technologies and their use. […] [G]uidelines for the use and programming of automated vehicles should be derived and communicated to the public and reviewed by a suitable, independent body." (Ethik-Kommission, 2017, p. 12). The news media play an important role in this process by framing risks, benefits, and governance of autonomous mobility in Germany. Local APT projects with public funding and the involvement of scientists and other stakeholders beyond the business domain are effective in facilitating largely positive media coverage. However, scientists and science communicators should professionalize their communication related to developing and testing APT technologies. Future research at the intersection of risk and science communication should further analyze institutional science communication about APT and its impact on public framing, as well as public acceptance across countries where the technology is introduced.

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Appendices

Table A.1. Frequency of frame element indicators by frame (in %)

Frame element	Frame element indicators		Frames (Clusters)[a]			Total
			Neutral traffic & business stories	Negative safety & governance concerns	Positive benefits of science & technology	
Problem definition	Risks/ problems	Lack of user competence	0.54	**16.67**	1.16	5.37
		Lack of acceptance	5.91	**35.42**	12.14	16.50
		Lack of safety/ limits of technology	9.14	**66.67**	20.81	29.62
		Ethical problems	3.23	**23.61**	0.58	8.15
		High costs	1.61	**13.19**	12.72	8.75
		Data protection problems	2.69	**28.47**	3.47	10.34
		Regulatory limitations	7.53	**38.19**	13.29	18.29
		Traffic problems	5.91	**40.28**	12.72	18.09
		Disruptions due to unexpected weather or road conditions	3.23	**27.08**	7.51	11.53
		Problems in interaction with other road users	1.08	**23.61**	3.47	8.35
	Benefits	Mobility and comfort	16.13	40.28	**57.23**	37.18
		Time savings and convenience	5.38	**18.06**	16.18	12.72
		Low individual costs	2.69	4.86	**9.83**	5.77
		Improved safety	10.22	**40.97**	24.28	23.86
		Economic benefits	17.20	41.67	**49.71**	35.39
		Environmental protection	5.91	18.06	**22.54**	15.11
		Low societal costs	0.00	7.64	**9.83**	5.57
		Solving traffic problems	13.98	31.94	**43.93**	29.42
	Damaged stakeholders	Human	3.76	**47.92**	2.31	15.90
		Company/ economy	3.23	**32.64**	3.47	11.73
	Beneficiary stakeholders	Human	11.29	44.44	**46.24**	32.80
		Company/ economy	9.14	35.42	**42.20**	28.03
		Science/ research	1.08	7.64	**15.61**	7.95

Causal attribution	Stake-holders responsible for risks/ problems	Human	0.54	**24.31**	0.00	7.16
		Car/ technology	3.76	**55.56**	5.78	19.28
		Company/ economy	1.08	**21.53**	0.00	6.56
		Politics/ legislature	1.08	**12.50**	4.62	5.57
	Stakeholders responsible for benefits	Car/ technology	10.22	50.00	**54.91**	36.98
		Company/ economy	2.69	11.11	**16.76**	9.94
		Science/ research	0.54	3.47	**11.56**	5.17
Moral evaluation	Evaluation tendency/ acceptance	Positive tendency/ acceptance	3.23	14.58	**98.27**	39.17
		Negative tendency/ lack of acceptance	0.00	**19.44**	0.00	5.57
		Balanced evaluation	**96.77**	65.97	1.73	55.27
Treatment recommedation	Recommendation for action/ solution	Promoting individual competence	0.54	**13.19**	2.89	4.97
		Technical development	1.61	**27.08**	8.09	11.13
		Expansion of infrastructure	1.61	6.94	**9.25**	5.77
		Creating a political/ legal framework	0.54	**15.28**	0.58	4.77
	Sender of recommendation	Human/ private individual/ user	1.08	**20.83**	1.16	6.76
		Company/ economy	1.61	**20.83**	10.40	10.14
		Politics/ legislature	0.54	**13.19**	3.47	5.17
	Receiver of recommendation	Car/ technology	0.00	**29.17**	8.09	11.13
		Company/ economy	0.54	**17.36**	4.05	6.56

Note. All frame element indicators are binary variables (mentioned/not mentioned). Values are relative frequencies (%) based on within-Cluster [a]Cluster 1 = Neutral traffic and business stories frame; Cluster 2 = Safety and governance concerns frame; Cluster 3 = Benefits of science and technology frame. *N* = 503.

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RESEARCH IN BRIEF

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A light shade of green: Nachhaltigkeitskommunikation von im Deutschen Aktienindex gelisteten Unternehmen auf X und Instagram

Marc Jungblut & Brigitte Narderer

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Marc Jungblut (Dr.), Ludwig-Maximilians-University Munich, Department of Media and Communication, Oettingenstr. 67, 80538 Munich, Germany. Contact: marc.jungblut@ifkw.lmu.de. ORCID: https://orcid.org/0000-0002-2677-0738
Brigitte Naderer (Dr.), Medical University of Vienna, Department of Social and Preventive Medicine, Centre for Public Health, Kinderspitalgasse 15, 1090 Vienna, Austria. Contact: brigitte.naderer@meduniwien.ac.at. ORCID: https://orcid.org/0000-0002-7256-7941

RESEARCH IN BRIEF

A light shade of green: German stock index listed companies' inclusion of sustainability communication on X and Instagram

A light shade of green: Nachhaltigkeitskommunikation von im Deutschen Aktienindex gelisteten Unternehmen auf X und Instagram

Marc Jungblut & Brigitte Narderer

Abstract: Our study examines the sustainability communication of German stock index-listed (DAX) companies on X (formerly Twitter) and Instagram. We examine the frequency and content of sustainability-related posts and seek to answer two main questions: The frequency and topics of sustainability communication among the 40 DAX companies (RQ1), and any patterns or differences based on their proximity to consumers (RQ2). We analyzed all tweets and Instagram posts of these companies from their inception to November 2022 (N_X = 642,897, $N_{Instagram}$ = 66,867), using a combination of machine learning classifiers to identify sustainability-related content and topic modeling to identify sustainability-related topics. Our findings highlight a significant pent-up demand in the prioritization of sustainability in the public communications of DAX-listed companies on social media.

Keywords: Sustainability communication, social media, topic modeling, supervised machine learning

Zusammenfassung: Die Studie untersucht die Nachhaltigkeitskommunikation von im Deutschen Aktienindex (DAX) gelisteten Unternehmen auf X (ehemals Twitter) und Instagram. Die Studie adressiert dabei explorativ zwei Forschungsfragen: Wie häufig und zu welchen Themen kommunizieren die 40 DAX Unternehmen in ihrer Nachhaltigkeitskommunikation (FF1)? Welche Muster und Unterschiede zeigen sich zwischen Unternehmen mit einer unterschiedlichen Nähe zu den Verbrauchern (FF2)? Um diese Fragen zu beantworten, analysieren wir alle Tweets und Instagram-Posts dieser Unternehmen vom Beginn der Account-Erstellung bis November 2022 (N_X = 642.897, $N_{Instagram}$ = 66.867), wobei wir eine Kombination aus Machine Learning Classifier zur Identifizierung von nachhaltigkeitsbezogenen Inhalten und Topic Modeling zur Identifizierung von Nachhaltigkeitsthemen verwendeten. Unsere Ergebnisse zeigen einen signifikanten Nachholbedarf bei der Priorisierung von Nachhaltigkeit in der öffentlichen Kommunikation auf sozialen Medien der im DAX gelisteten Unternehmen.

Schlagwörter: Nachhaltigkeitskommunikation, soziale Medien, Topic Modeling, Supervised Machine Learning

1. Introduction

We are currently witnessing many climate records being broken year after year, significant increases in ocean heat and sea level rise, as well as continued devastating weather hazards (Kennedy et al., 2024). The prevailing economic trajectories, characterized by relentless growth, are incompatible with the finite resources and delicate balance of our planet, yet financial contributions that directly harm the environment still exceed investments in nature-based solutions by a factor of 30 (United Nations Environment Programme, 2023). Minimizing emissions and limiting global warming require holistic solutions that involve public, political and economic actors. As major contributors to the climate crisis, companies are expected to act accordingly. Addressing sustainability has therefore become standard practice for companies in their internal and external communications (Seele & Lock, 2015).

Going beyond economic responsibility and addressing social and political concerns, such as sustainability efforts, is connected to a company's corporate social responsibility (CSR) (Halkos & Nomikos, 2021; Stohl et al., 2017) and thus CSR and sustainability are not only "closely related", but also "often used interchangeably" (Reilly & Larya, 2018, p. 1). External communication about sustainability can enhance a company's image, reputation, and consumer choices (Parguel et al., 2011, 2015). It can thus be used as a strategic tool for companies to operate socially legitimately. Communicating sustainability efforts is a relevant part of companies' annual CSR reports to improve reputation among external stakeholders (Reilly & Larya, 2018). Beyond these formal reports, companies also rely on other channels to communicate their sustainability agenda, in particular, social media (Etter, 2014). Social media is described as a channel of informal communication, as it is a potentially two-way interactive exchange with consumers and is not moderated or revised by other communicating agents such as journalists (Etter et al., 2018; Lundgaard & Etter, 2023; Reilly & Larya, 2018).

Social media is, therefore, another way for companies to position themselves publicly on issues such as their sustainability agenda, and how they do so is crucial to capturing the public discourse on this relevant and complex topic (Lock et al., 2024). And while previous studies have highlighted the importance of social media as a platform for companies to publicly position themselves on sustainability issues (DiRusso & Myrick, 2021; Lock et al., 2024; Reilly & Larya, 2018), there is limited understanding of how different types of companies strategically communicate their sustainability agendas on different social media channels. The topics discussed and the relevance of sustainability communication may vary depending on a company's proximity to consumers, with high consumer proximity (B2C) industries often relying more heavily on social media to engage key stakeholders than low consumer proximity (B2B) industries (Reilly & Larya, 2018). Despite these initial findings, little research has examined the nuances of sustainability communication across different social media channels and the differences in topics discussed concerning a company's consumer proximity. This study addresses this gap by analyzing the frequency, content, and industry-

specific strategies of sustainability-related posts among German stock index-listed (DAX) companies, shedding light on the different approaches companies take when using social media for sustainability communication.

2. Literature review

Discussions around sustainability have become a common focus for businesses, with sustainability efforts often being used interchangeably with CSR in academic literature (Seele & Lock, 2015) or at least considered a central aspect of CSR (Halkos & Nomikos, 2021; Stohl et al., 2017). It may be necessary to specifically define the discussion of sustainability in the context of a profit-driven business: In for-profit companies, sustainability is often aligned with financial growth, hence understanding environmental sustainability as a manageable long-term goal compatible with financial success (Kemper et al., 2019).

In a comparison of how different actors (i.e., the media, companies and consumers) discuss sustainability, Lock et al. (2024) show that the externally communicated corporate perspective on sustainability appears to be balanced. The analysis of the websites of the 100 biggest Dutch companies reveals that sustainability is discussed holistically as it covers societal, economic and environmental aspects. However, the results also indicate that it is still often used as a buzzword (Lock et al., 2024), pointing out a strategic and egocentric view of companies' sustainability efforts that might indicate the foremost goal of a company to bolster one's reputation (Parguel et al., 2011, 2015).

Although companies have responded to societal demands by actively promoting their environmental efforts, a recent content analysis of social media advertising by leading global companies shows that more than 70% of the claims made in advertising were misleading (Kwon et al., 2024), indicating a so-called greenwashing strategy (de Freitas Netto et al., 2020; Parguel et al., 2015). This strategy aims to enhance a company's image as environmentally friendly but often does not provide real insights into a company's environmental practices. Due to results like Kwon's (2024), it is particularly important to examine how companies communicate their sustainability efforts (de Freitas Netto et al., 2020) to determine their authenticity. More specifically, which issues related to sustainability elements companies refer to in their sustainability communication. For example, Lock et al. (2024) distinguish between six elements, namely environment (e.g., air quality), economy (e.g., production), society (e.g., politics), individual (e.g., health), development (e.g., research), and time (e.g., future generations), that communicators might refer to when discussing sustainability. By prioritizing certain topics over others, companies influence the public's perception of sustainability and may direct attention, resources, and collective efforts to specific areas (Etter et al., 2018; Scherer et al., 2016).

As Fernández et al. (2022), have observed, companies are guided by a number of factors when selecting which sustainability topics to prioritize in their online communications. The communication channel undoubtedly plays a pivotal role, particularly on social media, where interactivity and appeals that are oriented towards humanity play a significant part. However, social media also carries the risk of losing control of the public perception,

which could impact how companies position themselves on these platforms (Illia et al., 2017) or whether companies avoid positioning a sensitive topic like sustainability on social media altogether (Lundgaard & Etter, 2023).

Based on these assumptions, we want to understand the frequency (RQ1a) and, more importantly, what aspects (RQ1b) the 40 German DAX companies communicate about sustainability in their social media channels.

Yet, the relevance of communicating environmental, social, and philanthropic aspects (Byrum, 2019) might also vary depending on the type of company. Particularly, whether a company's profit comes from direct sales to customers or distribution to other companies may influence its public communication. So-called high-consumer-proximity industries (Fernandez-Feijoo et al., 2014) or business-to-consumer (B2C) industries need to engage customers as key stakeholders and might use communication channels such as social media for CSR and sustainability communication differently than low-consumer-proximity or business-to-business (B2B) industries (Reilly & Larya, 2018). While the use of social media for CSR purposes is well established (Etter, 2014), Reilly and Larya (2018) found that high-consumer-proximity industries seem to rely much more on social media for their external sustainability communication. Yet, it might be relevant to communicate sustainability efforts cautiously through social media, as they can create a backlash from the audience, particularly if consumers suspect a greenwashing intention (Topal et al., 2020).

Secondly, we thus want to understand whether we can find any patterns or differences in their communication depending on their consumer proximity (RQ2).

X and Instagram are among the most widely used social media platforms, both in Germany and worldwide. Moreover, both platforms are central venues for corporate communication and specifically CSR (Reilly & Larya, 2018). Therefore, we decided to analyze sustainability communication on these platforms, as this will provide valuable insights into the characteristics of corporate communication within today's hybrid media system.

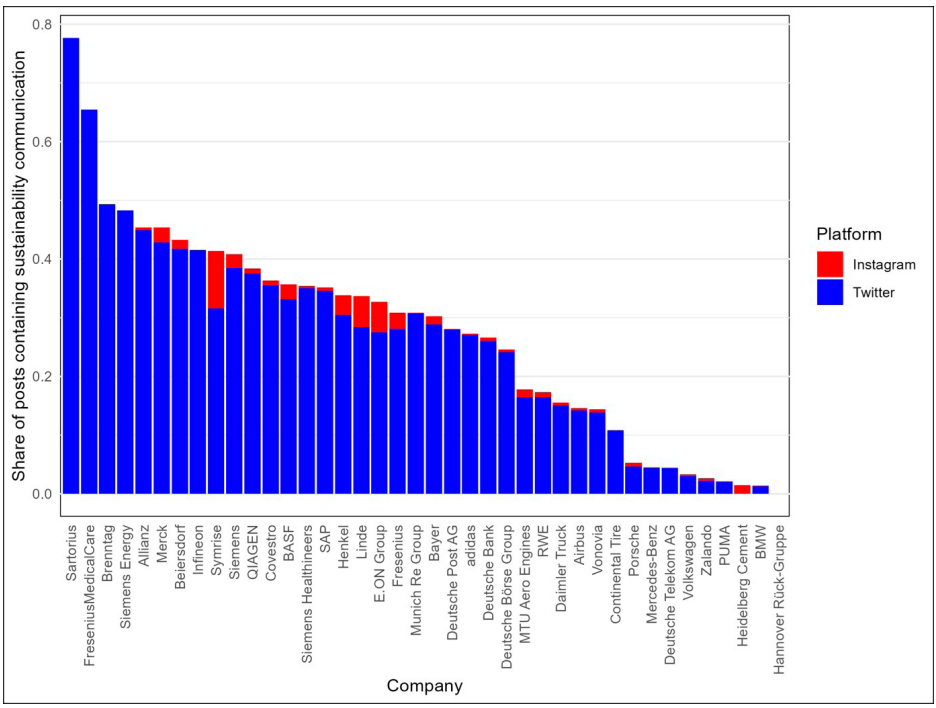
3. Method

To answer these research questions, we downloaded all tweets and Instagram posts from official accounts of the 40 German DAX corporations from their initial startup until the end of November 2022 (N_X = 642,897, $N_{Instagram}$ = 66,867)[1]. For Twitter, we relied on the then-available Twitter Developer API (data accessed on 01.12.2022) and for Instagram, we used CrowdTangle (data accessed on 07.12.2022) to acquire data.

We trained a naïve Bayes, a support vector machine and a maximum likelihood machine learning classifier to identify posts that can be labeled as sustainability communication. Finally, we combined our classifiers into an ensemble classifier, where a post is considered to contain sustainability communication if the majority of classifiers predict this. The classifiers were trained using a 75/25 test-training split on

1 We machine translated all non-English texts to English with the googletranslateAPI ($n_{non\text{-}English}$ = 124,082). The final sample size after preprocessing and exclusion of empty posts is N = 709,448.

Figure 1. Share of posts containing sustainability communication across German DAX40 companies on Twitter and Instagram



2,500 manually coded posts. A trained student coder was provided with a definition of sustainability communication and relevant examples to determine whether a post contained sustainability communication. Intercoder reliability between the coder and one of the authors was satisfactory (n = 100, α = .89). The ensemble classifier was chosen for its superior performance, which was within acceptable limits (*Accuracy* = .83, *Precision* = .63, *Recall* = .69, *F1* = .66, see: Pilny et al., 2019). Still, despite this overall acceptable performance, the comparatively high false-positive and false-negative rates call for a cautious interpretation of results.

We then ran a series of unconstrained STM-topic models on posts that were labeled sustainability communication.[2] Based on semantic coherence, exclusivity and interpretability, we decided to use a model with five topics. The topics were then validated by a trained student coder who was provided with brief descriptions of the five topics and a few salient examples. The coder reviewed 500 posts (100 per topic) to identify the dominant topic, with Krippendorff's Alpha (α = .76) indicating satisfactory agreement between the human coder and automated classification. All data and scripts can be found on OSF (https://osf.io/64xbs/?view_only=3448b722f3394bf1ad93e77cea672f89).

2 We ran models for k = 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95 and 100.

4. Results

To answer RQ1a, we first analyzed the frequency of sustainability posts. Overall, 16.6% of the posts were classified as sustainability communication (n = 117,721). Interestingly, the share of tweets (17.8%) that talks about sustainability is significantly larger than the share of Instagram posts (5,4%, $\chi^2(1) = 66680.58$, $p < .001$, $V = .01$). Moreover, the share of posts that contain sustainability communication varies largely across companies from 0% (Hannover Rück-Gruppe) to up to 78% (Sartorius). Figure 1 provides an overview of the share of posts on sustainability across accounts.

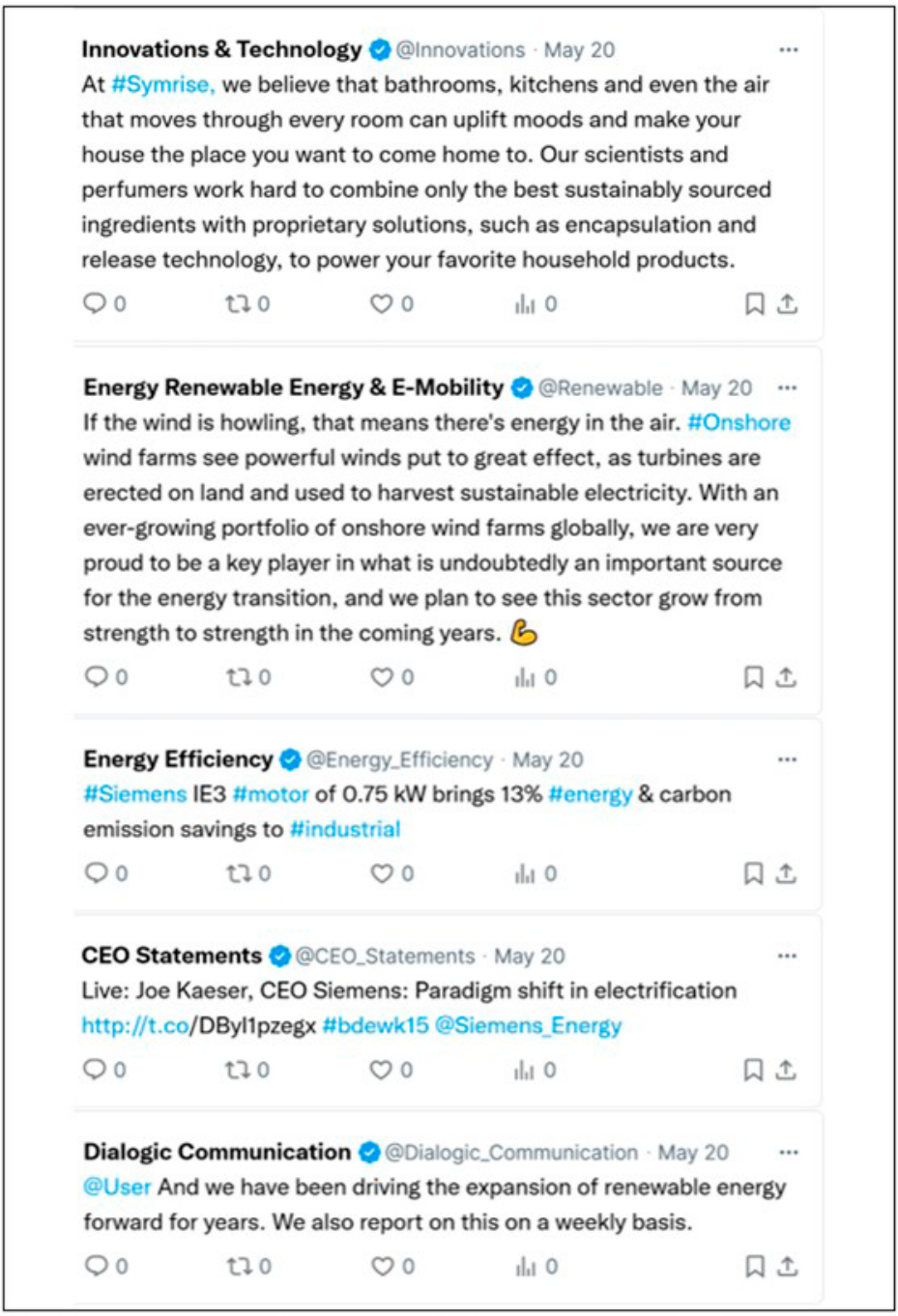
RQ1b asks about the topics that companies talk about when they post about sustainability. Our topic model identified five different topics, which we interpreted based on relevant features and texts with a strong presence of a topic. The first topic mentions sustainability when talking about "*Innovations and Technologies*". Here, sustainability is not at the center of attention but rather presented as one out of a set of features of new developments. This topic has an average topic loading of .61 and making it by far the most dominant topic in the corpus. The second topic talks about "*Renewable Energy & E-Mobility*" and has an average topic loading of .19. The third topic was called "*Energy Efficiency*" and has an average topic loading of .11. Next, the fourth topic consists of "*CEO statements, press releases, awards and competitions*" and has an average topic loading of .05. Lastly, there is a topic called "*Dialogic Communication*" in which companies either ask users for their opinion or engage in a dialogue with users about sustainability topics. This topic also has an average topic loading of .05. Figure 2 provides an overview with salient examples of the five topics.

RQ2 asks about differences in sustainability communication based on companies' consumer proximity. To do so, we compare the communication of companies that only deal directly with customers (B2C) and those that also or exclusively deal with other companies (non-B2C). First, the analysis indicates that the share of posts of B2C companies (10.3%) that refer to sustainability is significantly smaller than of those that do not only directly deal with costumers (30.3%, $\chi^2(1) = 44122.27$, $p < .001$, $V = .25$). To unravel differences in topic prevalence, we computed unpaired t-tests to compare the average topic loadings between the two groups of companies.[3] The results indicate that B2C companies rely significantly less on the topics "*Innovations and Technologies*", "*Renewable Energy & E-Mobility*" and "*CEO statements, press releases, awards and competitions"*, while they significantly stronger rely on the topics "*Energy Efficiency*" and "*Dialogic Communication"* (see Table 1).[4]

3 We are aware of the ongoing debate about the necessity of using inferential statistics on superpopulation data. In this context, we primarily follow the suggestions of Broscheid & Gschwend (2005), who argue that even when working with full population data, inferential statistics are necessary to empirically test general explanations.

4 As requested by one of the reviewers we created figures on the temporal dynamics of the share and number of sustainable post (Figure A1) and on the relative relevance of topics across time (Figure A2). These figures can be found on OSF.

Figure 2. Visualization of examples of posts containing the five identified topics



Note: Due to privacy and copyright concerns, visualizations were created through mock-up posts from www.tweetsim.com.

Table 1. Unpaired t-test for differences in average topic loadings between business to consumer business to business (B2C) and non-B2C companies

Topic	B2C-companies *M*(*SD*)	Non B2C-companies *M*(*SD*)	*t*(df), *p*, *d*
Innovations and Technologies	.54(.24)	.65(.14)	*t*(117717) = -96.1, *p* < .001, *d* = -.5
Renewable Energy & E-Mobility	.16(.12)	.20(.10)	*t*(117717) = -63.5, *p* < .001, *d* = -.3
Energy Efficiency	.19(.32)	.04(.06)	*t*(117717) = 119, *p* < .001, *d* = .7
CEO statements, press releases, awards and competitions	.05(.06)	.06(.07)	*t*(117717) = -28.9, *p* < .001, *d* = -.1
Dialogic Communication	.05(.11)	.04(.07)	*t*(117717) = 20.5, *p* < .001, *d* = .1

Notes. n = 117.719

5. Discussion

Our analysis of DAX-listed companies' communication gives a first indication that they do not prioritize sustainability communication on their social media channels. Indeed, only 17% of all posts focus on this issue. This may be attributed to the fact that social media is a potentially discursive platform where prospective consumers may disseminate their appraisals of a company's stance on social issues, and potentially also offer constructive criticism of the organizational activity. Therefore, the content shared within the public discourse must be carefully considered (Etter et al., 2018; Lundgaard & Etter, 2023).

When companies in our study do engage in informal communication of their CSR activities and their attitudes and measures towards sustainability (Reilly & Larya, 2018), the predominant topic focus is on innovations and technologies. In this context, sustainability is frequently subsumed by the focus on the technical specifications of new developments. This indicates that companies in our sample utilize sustainability as a means of advancing innovation, thereby potentially prioritizing economic growth and progress over genuine sustainability endeavors (Kemper et al., 2019). This is consistent with the findings of Angst and Strauß (2023), who, in their study of European Twitter discourses between 2010 and 2021 on digitalization and sustainability, show a predominant focus on an efficiency-driven discourse with little critical reflection on economic growth.

Other focal points include "Renewable Energy and E-Mobility," "Energy Efficiency," "CEO statements, press releases, awards and competitions," and finally "Dialogic Communication." Thus, the least utilized approach in our study is that of companies soliciting user opinions or engaging in discussions about sustainability topics. These findings indicate that DAX-listed companies tend to present information in a one-sided manner, focusing on presenting sustainable innovations and practices, as well as the promotion of third-party recognition. This adds to the observation of Lock et

al. (2024) that companies simply buzzword sustainability in the public communication without having a meaningful exchange with consumers. This contrasts with the use of social media as a tool for two-way communication (Topal et al., 2020).

A somewhat surprising result of our analysis is that the examined B2C companies rely less on sustainability communication than non-B2C companies. This finding is contradictory to previous research (Reilly & Larya, 2018). However, as Etter et al. (2018) point out, social media increases a company's transparency and accountability to its stakeholders. In the case of B2C companies, consumers are the most important stakeholders, which explains why B2C companies still rely more on dialogic communication than non-B2C companies. Nevertheless, the dialogic potential is generally limited. We argue that while B2C companies are expected to be transparent, it is more difficult for them to present a polished image without exposing themselves to outside scrutiny. Furthermore, the company cannot fully control the public discourse, as consumers can influence communications. Consumer feedback can force companies to address issues they had not previously prioritized, leading to a reallocation of resources or reputational risk. This reluctance to engage in sustainability messaging may also stem from greenhushing – a tactic that, unlike greenwashing, downplays environmental efforts to avoid scrutiny (Font et al., 2017). Companies may find it challenging to steer or respond effectively, leading to hesitation to prioritize social media for sensitive topics like sustainability (Lundgaard & Etter, 2023). Thus, the observed avoidance of using social media for sustainability messaging may reflect a strategic calculation to minimize reputational risks while maximizing control over the public image through other forms of communication (Illia et al., 2017). Companies may therefore prefer to emphasize marketing channels that offer more control, balancing their sustainability goals with reputation management strategies.

Moreover, B2C companies tend to discuss sustainability in slightly different topics than non-B2C companies, putting a stronger focus on energy efficiency as a topic that directly affects consumer costs and a lower focus on more abstract aspects like the use of renewable energy in production, CEO awards for sustainability, or innovative technologies in product processes. This is because these issues relate less strongly to the stakeholders these companies prioritize.

6. Practical implications

The results indicate that DAX companies currently provide only limited information about their sustainability efforts and rarely engage in dialogue with social media users. Instead, the focus is on sustainability as a means of promoting innovation, possibly prioritizing economic growth and progress over genuine sustainability efforts. These efforts may erode the credibility and effectiveness of companies in engaging consumers. It is recommended that companies adopt a more balanced approach that includes dialogic communication in order to foster a more interactive and trust-building relationship with their audience. In light of the growing recognition of corporate responsibility, it is worth considering whether companies should accept that their sus-

tainability messaging may not necessarily result in immediate persuasion. Rather, it may contribute to a broader deliberative process by influencing public opinion and stakeholder expectations over time (Lundgaard & Etter, 2023). Businesses, in particular those with a high degree of consumer proximity, need to utilize a diverse array of communication channels, extending their social media presence, to more effectively convey their sustainability initiatives and thereby enhance their contribution to societal discourse on sustainability (Etter et al., 2018; Illia et al., 2017; Lundgaard & Etter, 2023).

In our study, we observe a tendency for companies to favor innovation and economic benefits over genuine sustainability initiatives in social media communication (Kemper et al., 2019). This goes along with a lack of interest in dialogic forms of sustainability communication. Together, these aspects have the potential to mislead or misdirect consumers. It is the responsibility of policymakers to monitor this behavior and the reasons behind it. Furthermore, literacy efforts to educate social media users about companies' persuasion intentions and tactics seem warranted (Naderer & Opree, 2021).

7. Limitations

The present paper offers a descriptive overview and exploratory examination of two social media channels utilized by DAX-listed companies. While X and Instagram are relevant, X has significantly changed since the data collection for this study, with numerous companies and advertisers having left the platform. Moreover, this analysis does not encompass other communication channels, such as formal advertising, formal CSR reports, or public relations efforts in the news media. Consequently, only one aspect of sustainability communication was assessed in this study. Additionally, since we only analyzed the frequency and topics of sustainability communication, we cannot determine how much of it includes concrete measures versus greenwashing or strategic ambiguity (Sim & Fernando, 2010). Thus, our analysis reflects the companies' communication, not their actual actions.

Methodologically, for the sake of reproducibility and simplicity, we chose to use a machine learning classifier to identify sustainability communication. While the classifier performed within an acceptable range of validity, it is important to acknowledge the implications of the performance measures, specifically that the false positive and false negative rates are approximately one-third. These figures suggest that a significant portion of posts may be misclassified, and this should be considered when interpreting the findings. Future research could focus on refining the model or exploring advanced methods, such as incorporating Large Language Models, to enhance performance and address these limitations.

Finally, our topic model may have captured results on two different conceptual levels. The topics "Dialogic Communication" and "CEO statements, press releases, awards, and competitions" seem to have a distinct conceptual nature, focusing on the form of communication rather than solely its content. This could explain the overall low topic loadings for these categories, as CEOs, for instance, often address substantive topics in their statements, while the topic itself may only load on terms indicating the pre-

sence of a CEO statement. Although these topics remain computationally valid and were identified through manual content analysis, further exploration of their co-occurrence with other topics would be a valuable next step.

8. Conclusion

Reducing greenhouse gas emissions and keeping global temperature rise within manageable limits requires holistic solutions involving public, political, and economic stakeholders. Since companies are significant contributors to the climate crisis, there is a public expectation for them to take responsible actions. Our findings suggest that there is still some way to go in making sustainability efforts a priority, as evidenced by the lack of consideration of this aspect in the public communication of DAX-listed companies on social media.

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