

## Dynamics of Content Diversity within Issues, Across Platforms: A Pesticide Debate in the News and on Twitter

ANKE WONNEBERGER

SANDRA JACOBS

IINA HELLSTEN

University of Amsterdam, The Netherlands

Diversity of represented viewpoints in media content is a vital aspect of democratic societies. Building on insights about content diversity between topics, this study assesses frame and actor diversity within an issue and across media platforms. We conducted a manual quantitative content analysis of frames and actors in Dutch Twitter posts ( $N = 2,224$ ) and newspaper articles ( $N = 318$ ) about the banned pesticide fipronil, and we compared categorical and relative diversity of frames and actors between platforms. The results revealed an overall higher diversity for newspaper articles compared with tweets. Most strikingly, the diversity dynamics were quite similar in newspaper content and Twitter messages, but this similarity vanished once we distinguished between diagnostic and prognostic actor and frame diversity, with news articles showing a greater focus on solutions. The proposed diversity measures help discern temporal stages within issues and contribute to our understanding of inraissue dynamics across media platforms.

*Keywords: frame diversity, actor diversity, content diversity, issue arenas, Twitter, fipronil*

News media are often assumed to provide a rich variety of voices and perspectives, and thereby to function as a marketplace of ideas fulfilling a democratic role for the formation of public opinion. Accordingly, scholars have assessed a variety of aspects linked to the diversity of news media, news content, actors, or frames (Hendrickx, Ballon, & Ranaivoson, 2022; Joris, Grove, Damme, & Marez, 2020; Loecherbach, Moeller, Trilling, & van Atteveldt, 2020; Masini, 2019). Diversity is a central concept used to assess the quality of news media. Different types of news or media diversity are assessed on either the production side (i.e., news organizations, journalists, media content; Hendrickx & Van Remoortere, 2021; Wolfgang, Vos, Kelling, & Shin, 2021) or the exposure side (i.e., diversity within individual media menus; Hoffman, Lutz, Meckel, & Ranzini, 2015; Kim & Kwak, 2017). Although media organizations carry a large responsibility for the representation of viewpoints in public discourses, the expansion of digital public spheres to other platforms that are not controlled by news organizations (e.g., Papacharissi, 2002; Schäfer, 2016) raises the question to what extent the diversity of viewpoints in public discourses is affected by such

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Anke Wonneberger: a.wonneberger@uva.nl

Sandra Jacobs: s.h.j.jacobs@uva.nl

Iina Hellsten: i.r.hellsten@uva.nl

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alternative, user-generated platforms. Given the growing impact of social media on individual news consumption (Scheffauer, Goyanes, & Gil de Zúñiga, 2021), in addition to their specific discursive formats (Johnson, 2018), this creates the need to compare diversity between journalistic media outlets and social media platforms. Specifically, Twitter has been considered as a platform that allows the representation and exchange of diverse viewpoints (Wonneberger, Hellsten, & Jacobs, 2021) and as the main social medium used for information and news purposes (Boukes, 2019). Newspapers, in contrast, can be expected to uphold journalistic standards related to diversity most strongly (Hendrickx et al., 2022; Masini et al., 2018).

To directly compare content diversity found on Twitter and in newspapers, the present study focuses on diversity within a single issue. We apply the concepts of actor and frame diversity to further add to our understanding of how public discourse about specific issues compare across media platforms (Masini et al., 2018; Voakes, Kapfer, Kurpius, & Chern, 1996). Literature on so-called issue arenas suggests that particularly the over-time dynamics between competing frames and actors within issue arenas are understudied (Vos, Schoemaker, & Luoma-aho, 2014). Moreover, the attribution of responsibility for the causes of an issue and its solutions is inherent to discussions about societal problems (Entman, 1993; Ketelaars, 2016). For this reason, we distinguish between diagnostic and prognostic frames, as well as between actors who are held responsible for either causing or solving the issue. Issue arenas are not limited by the boundaries of specific media, but surprisingly little is known about how discussions about issues develop across medium types, for example in traditional news media and on Twitter (van den Heijkant, van Selm, Hellsten, & Vliegthart, 2019; Vos et al., 2014). With this study, we seek to answer the question of how frame and actor diversity develop over the course of an issue, and to what extent this differs between newspapers and online media platforms.

We develop an intraissue approach for the analysis of societal debates. As an exemplary case study, we analyze the public debate held in newspapers and on Twitter about the use of the banned pesticide fipronil in the Netherlands. In 2017, fipronil was illegally used to combat lice in poultry farms and was found in chicken eggs that were sold in the supermarkets. This led to large-scale recall of eggs from consumer markets and triggered a heated public health debate.

### **Intraissue Diversity Across Media Platforms**

There is an ongoing discussion about the role of the Internet and, specifically, of social media, in providing platforms for digital public spheres (Dahlgren, 2005; Papacharissi, 2002; Schäfer, 2016). Openness and accessibility belong to the main features of social media that contribute to heightened expectations of their potential as public spheres as opposed to mass-mediatised public spheres. Research found an increased capacity of Twitter to pay attention to a broader variety of issues and actors compared with mainstream media (Rogstad, 2016). Questions concerning the consequences of the rapidly changing digital media environment for the quality of public discourses have caused a renewed interest in the study of media diversity or news diversity (Joris et al., 2020; Loecherbach et al., 2020). News or media diversity is a multidimensional concept, and the variety of different theoretical and operational definitions in the literature demands an explicit and clear account of the approach that will be followed in this research. On a general level, media diversity has been discerned into source, content, and exposure diversity (Napoli, 1999). A more recent model further discerns source diversity into ownership, brand, and production diversity

(Hendrickx et al., 2022). Although the diversity of content providers and exposure and reception processes are certainly relevant in a social media context (Hoffman et al., 2015; Napoli, 2011), the current study focuses on the diversity of media content.

Content diversity has multiple dimensions and can be considered a fragmented concept in itself (Joris et al., 2020). On a general level, content diversity assesses the representation of the variety of characteristics such as issues, actors, viewpoints, or nationalities in news or media content (Napoli, 1999). Most studies therefore assess content diversity on the outlet level by comparing, for instance, across news outlets or countries (e.g., Hendrickx & Van Remoortere, 2021; Kleinnijenhuis, Schultz, & Oegema, 2015). Such studies often set out to investigate the consequences of media ownership concentration (e.g., Hendrickx & Van Remoortere, 2021; van Cuilenburg, 1999) or different media systems (e.g., Humprecht & Esser, 2018), whereas another strand of research is concerned about the content diversity within single issues. Previous research has compared content diversity of issue-specific newspaper coverage across countries (Benson, 2009; Masini et al., 2018). Specifically, framing research has studied how involved actors, such as media and organizations, differ in the diversity of frames they use (Gerken & van der Meer, 2019). So far, however, there is limited knowledge concerning the intraissue diversity across media platforms. The relatively narrow level of content diversity of a specific issue is suitable for a comparison across journalistic and nonjournalistic platforms as this allows to zoom in on platform-specific mechanisms and dynamics. Although diversity of journalistic representations is affected by journalistic norms, media formats, and economic considerations (Hendrickx & Van Remoortere, 2021; Hendrickx et al., 2022), the logics of semantic and social networks may be the main driving forces of content diversity of user-generated discourses (Bozdog, Gao, Houben, & Warnier, 2014; Hellsten, Jacobs, & Wonneberger, 2019). However, both contribute to the quality of public debates in democratic systems.

Being thus linked to the normative issue of public spheres, scholars have pointed to the importance of formulating explicit normative assumptions as a starting point to assess various aspects of content diversity, and at the same time, various normative approaches or models have been discussed (Joris et al., 2020; Raeijmaekers & Maesele, 2015). Normative expectations on public spheres are rooted in different models of democracy that put distinct demands on the representations of viewpoints. Liberal models of democracy require an exchange of ideas (Napoli, 1999; Voakes et al., 1996). Linking content diversity to the metaphor of a marketplace of ideas thus requires journalists to mirror existing viewpoints. This can be translated either as providing equal opportunities for existing actors and their viewpoints or as reflecting the current proportionality of these viewpoints in society (Joris et al., 2020; van Cuilenburg, 1999). The deliberative model adds to this basic idea of social representation that media need to allow for a negotiation of viewpoints or deliberation (Dahlgren, 2005). Whereas deliberation is aimed at reaching a consensus, the agonistic pluralist model of democracy stresses that conflicting viewpoints are vital for an inclusive public debate (Mouffe, 2000). Hence, from this perspective the diversity of viewpoints is more strongly focused on existing power relations and underrepresented or even absent voices (Raeijmaekers & Maesele, 2015). A key difference between the liberal model and the deliberative or agonistic model is a shift from diversity as representation to diversity as discursive practices (Raeijmaekers & Maesele, 2015). The analysis of discursive practices is only possible if we look at diversity as a process. We keep this range of normative perspectives in mind, and in the following sections, we discuss frame and actor diversity in more detail with the specific aim to take the dynamic aspect of diversity as a process into account.

### ***Dimensions of Intraissue Content Diversity: Comparing Actor and Frame Diversity***

Research on content diversity has considered various content dimensions, which has resulted in relatively scattered conceptualizations and hindered comparability across studies and contexts (Joris et al., 2020). Often the research context and questions are guiding with, for instance, diversity of political parties and issues considered as relevant for election coverage (van Hoof, Jacobi, Ruigrok, & van Atteveldt, 2014), whereas the study of identity discourses may focus on a broader range of identity markers, such as gender, ethnicity, or religion (Raeijmaekers & Maesele, 2015). Because our aim is to develop a framework that is more generally applicable for the study of discourses about specific issues, we focus on actors and frames as the two most commonly applied dimensions of content diversity (Joris et al., 2020; Masini et al., 2018).

To assess the representation of the marketplace of ideas and discursive practices in the public sphere, it is vital to discern the content of ideas and actors related to those (Voakes et al., 1996). In particular within journalism studies, previous research has focused on content diversity in the news as a presumption for democratic debates and therefore on the representation of actors on the one hand and associated frames or viewpoints on the other hand (Baden & Springer, 2017; Masini et al., 2018; Wolfgang et al., 2021). Both frames and viewpoints are thus used to assess the content of ideas, at times conceptualized in similar manners and sometimes used interchangeably (Baden & Springer, 2017). Although we discuss operational differences in the following sections, we will refer to frame diversity as the broader concept.

Comparing actor and frame diversity within and across issues has revealed that these two aspects of content diversity are independent but also interrelated dimensions (Humprecht & Esser, 2018; Masini & Van Aelst, 2017). Previous research has mapped actor and frame diversity within single issues across different journalistic channels such as popular and quality newspapers (Masini & Van Aelst, 2017) or online-only and legacy news sites (Humprecht & Büchel, 2013). Thus far, a comparison of journalistic and user-generated content is missing. Moreover, we add to this line of research by focusing on the intraissue diversity of actors and frames over time.

### ***Dynamics of Intraissue Diversity Described by Diagnostic and Prognostic Elements***

Diversity can be connected to the two core communicative acts in issue arenas: the definition of an issue or problem (diagnostic) and the discussion of possible solutions (prognostic; Snow, Vliegenthart, & Ketelaars, 2019). Both the diagnostic and prognostic part of a debate can be assumed to be in flux and in a dynamic relationship toward each other. These dynamic processes have consequences for the development and consequences of a public debate. More specifically, one could expect that in the beginning of a crisis or "disruption of the social order" (Patriotta, Gond, & Schultz, 2011, p. 1829), the attention is focused toward sense-making of the issue at hand and problem definition, followed by the introduction and discussion of solutions (Kleinnijenhuis et al., 2015; Patriotta et al., 2011). The discussion of problem definitions followed by a focus on solutions also is in line with the dynamics described as issue attention cycles (Downs, 1972). Moreover, whereas during early stages of a crisis, typically a broader range of problem definitions and solutions are proposed, continued negotiation may lead to higher levels of agreement (Patriotta et al., 2011; van der Meer, Verhoeven, Beentjes, & Vliegenthart, 2014). This captures specifically deliberative assumptions of actors negotiating their viewpoints to reach consensus (Dahlgren, 2005). We apply this to

issue arenas and propose that discerning problem definition and solutions in relation to both frames and actors can help us discern different stages of public debates in issue arenas, by studying when and how specific frames and actors are introduced in the debate.

#### *Frame Diversity*

Frame diversity describes the “variety of different associations” that are represented with an issue (Kleinnijenhuis et al., 2015, p. 3). Studying frames offers more concrete insights of content diversity as opposed to, for instance, assessing the mere presence of opposing viewpoints (Humprecht & Esser, 2018). As commonly understood, framing involves the selection and communication of specific aspects of an issue that define a problem and related causalities and propose a moral evaluation and solution (Entman, 1993). Issues subject to public discourses are typically problems for which solutions are negotiated. Discerning prognostic and diagnostic frames can therefore describe different stages of a debate (Snow et al., 2019). In contrast with generic news frames that can be found across issues (de Vreese, Peter, & Semetko, 2001), diagnostic and prognostic frames are issue-specific frames that have been studied previously to assess frame diversity (Masini et al., 2018). Diagnostic frames describe situations as problematic or unjust and help identify the origin and nature of a problem, that is, its causes and consequences. Prognostic frames include the range of possible solutions brought up during a debate (Snow et al., 2019). These two framing tasks are key aspects that actors focus on when articulating and elaborating frames (Snow et al., 2019). Hence, these can be assumed to capture the variety of viewpoints held by various actors because disagreement and conflict among actors can arise with respect to how they define a problem and what solutions they propose. Changes of these positions may thus reflect stages in frame negotiation processes (Baden & Springer, 2017; Patriotta et al., 2011). The definitions of diagnostic and prognostic frames oftentimes include actors who are held responsible for causing or solving the problem, but this study captures responsibility attributions as a measure of actor diversity (Harder, Sevenans, & Van Aelst, 2017; Hellsten et al., 2019).

#### *Actor Diversity*

“Issues arenas” have been introduced as (virtual) places where debates about societal issues take place (Luoma-aho & Vos, 2010). In these arenas, actors (e.g., activist groups, citizens, journalists, companies, and other stakeholders) debate a specific topic such as racism, food safety, or climate change (Luoma-aho & Vos, 2010). Debates about issues are said to carry the capacity to affect organizational reputation and might lead to political agenda-setting (Barberá et al., 2019; Luoma-aho & Vos, 2010). Previous research on issue arenas often employs a corporate-centered perspective (Luoma-aho & Vos, 2010; Meriläinen & Vos, 2015) or takes a specific issue as a starting point to identify stakeholders and their positions (Hellsten et al., 2019; Zhang, Vos, Veijalainen, Wang, & Kotkov, 2016). We follow the latter strand and are specifically interested in actors who are held responsible for either the origin of the issue or solution to the issue, because discussions about (societal) problems elicit attributions of responsibility (Coombs, 2007). These attributions for the responsibility can be directed toward actors (corporations, consumers, or political actors) as well as toward the substance of the discussion: diagnostic and prognostic framing elements (Ketelaars, 2016; Snow & Benford, 1988).

Previous research on actor diversity has considered active as well as passive actors, clearly focusing either on the sources of ideas (Humprecht & Esser, 2018; Masini & Van Aelst, 2017; Masini et al., 2018) or

on the mere mentioning of actors, and thus not discerning active and passive roles (Humprecht & Büchel, 2013; Humprecht & Esser, 2018). Although sources of viewpoints are certainly relevant, differences in source diversity between traditional news media and social media seem to be strongly linked to platform-specific affordances. This is why instead of comparing newspaper articles and tweets with respect to the authors of viewpoints, we study within-message references to actors in terms of their allocated responsibility for either causing or solving the issue. Thus in contrast with source diversity, actor diversity in this study describes how actors are addressed within issue arenas, not their “active” participation. This passive participation constitutes a vital part of the issue arenas (Hellsten et al., 2019; Luoma-aho & Vos, 2010). Most important, however, we are interested to what extent actors are explicitly linked to either diagnostic or prognostic elements of an issue, and thus discern diagnostic and prognostic responsibility attributions.

In sum, to describe and compare levels of diversity and diversity dynamics within issue arenas, we discern frame and actor diversity. In addition to these two general concepts that comprise of the diversity of frames and actors present in a given debate and at a given point in time, we introduce the distinction between diagnostic and prognostic frame diversity and diagnostic and prognostic actor diversity with the aim to more clearly discern intraissue dynamics at different stages of a public debate. In our research questions, we first address representative aspects of diversity derived from a liberal model of public spheres:

*RQ1: To what extent does the degree of (diagnostic and prognostic) frame and actor diversity within an issue arena differ between social media and traditional news media?*

Second, the discursive process underlying specifically the deliberative model of public spheres leads us to study the dynamics of diversity:

*RQ2: How does the degree of (diagnostic and prognostic) frame and actor diversity within an issue arena develop over the course of the issue, and to what extent does this differ between a digital arena and traditional news media?*

*RQ3: To what extent can we discern different stages of an issue based on the distinction between diagnostic and prognostic frame and actor diversity?*

## **Method**

### ***The Issue of Fipronil in the Netherlands***

As an exemplary case in this study, we compare frame and actor diversity across media platforms for the societal issue of fipronil in the Netherlands. In 2017, the banned pesticide fipronil was found in chicken eggs and triggered a heated public health debate. Health concerns and high levels of public attention led to a large-scale recall of eggs from supermarkets and had economic and reputational consequences for poultry farmers. This issue is suitable as a case because the public debate had a clear starting point and spanned a relatively brief period, allowing us to take the entire issue cycle into account.

### **Research Design, Sample, and Data Collection**

To assess the degree of actor and frame diversity in the issue arena about fipronil, we conducted a manual quantitative media content analysis of newspaper coverage and social media posts. The research period spanned the period of main public attention for this issue over 16 weeks, from July to October 2017. The newspaper database *LexisNexis* was used to collect relevant newspaper articles from three national newspapers (*de Volkskrant*, *het Financieële Dagblad*, *de Telegraaf*) and, because of the regionally focused nature of the issue, two relevant local newspapers (*Dagblad van het Noorden*, *de Gelderlander*). The search string “fipronil OR gifei [poisoned egg]” yielded  $N = 318$  articles.

We selected Twitter as the most relevant social media platform for this study. Citizens’ motivation to use Twitter is related to news purposes (Costera Meijer & Groot Kormelink, 2015). In the Netherlands, the platform fulfills an important function in both the construction of the news and informing citizens about current affairs (Boukes, 2019). Relevant Twitter posts were collected via *Coosto*. This commercial social media monitoring and management tool collects content of several social media platforms and other channels in the Dutch-language area. Applying the same search string yielded a total of  $N = 30,468$  posts. Based on this initial sample, we collected a subsample that included only tweets of authors who contributed more than 20 posts to the debate ( $N = 9,951$ ). This selection made sure that tweets that addressed fipronil as a side issue or used the keywords in a different context were less likely to be included. This procedure let us to focus on original tweets, ensuring that diversity scores were not overly influenced by a few influential or viral tweets that obtained many retweets. For feasibility, a random selection of about one-quarter of these tweets were manually coded and, in this process, checked for issue relevance. This resulted in  $N = 2,224$  relevant tweets that were posted by the most active authors and were included in our analysis.

We developed a codebook that included media references, actor types, and framing elements. The coding categories were partly based on earlier research on frames and actors in social media debates. These existing categories were refined on the basis of an initial selection, reading of the research materials, and discussions during coder training, hence, applying a combination of a deductive and inductive approach (Matthes & Kohring, 2008). Specifically, with respect to the frames we aimed at covering the entire range of possible diagnostic and prognostic framing elements. As a result, 12 diagnostic framing elements, 10 prognostic framing elements (e.g., related to usage of pesticides, regulation of such use, or health concerns), and two responsibility frames were included in the codebook. Table A1 provides an overview of these elements.

The range of actors coded comprised several societal fields and included citizens, nonprofit organizations, media, politics, public authorities, fipronil producers and suppliers (pesticide companies), other industry actors (e.g., farmers, supermarkets), financial actors, and scientists. Several subcategories were used for most actor types to facilitate clear coding decisions. In a first step, a maximum of six actors was coded in the order of their appearance in the news item or tweet. Next, after the coding of the framing elements, the coders checked whether these actors were explicitly linked to either diagnostic or prognostic frames as responsible actors. If this was the case, a maximum of six actors could be coded as responsible for causing the issue or responsible for its solution.

Two student coders were recruited based on their Dutch-language skills and prior experience with content analysis. After several training and testing sessions, intercoder reliability was assessed based on a randomly selected subsample of  $N = 252$  newspaper articles and tweets—about 10% of the total sample, with the representation of both media types reflecting their share in the total sample. Krippendorff's alpha was calculated per frame and actor variable (scores per frame in Table A1). Initial low scores ( $<.7$ ) were discussed and assessed on smaller subsets of articles, yielding overall acceptable scores for most frames. No intercoder reliability could be determined for three frames that were not present in the subsample. However, with frequencies of  $<1\%$ , their contributions to the diversity measures could be neglected. The scores for the first two mentioned actors were similarly sufficient, with  $.724$  and  $.786$ , respectively, for diagnostic responsibilities and  $.778$  and  $.777$ , respectively, for prognostic responsibilities (hardly more than two actors were coded as responsible for causing or solving the issue).

### ***Diversity Measures***

Following previous research, we employed and compared two different measures of frame and actor diversity. Categorical diversity is reflected by the number of frame or actor categories used and provides insights on diversity degrees in an absolute sense (Peter & de Vreese, 2003). Because this measure is based on the number of available categories and is thus sensitive to the type of text (i.e., longer newspaper articles in comparison to short Twitter posts), a comparison across diversity types and platforms is limited. For this reason, we computed entropy as a standardized and most often used measure of relative diversity (e.g., Kleinnijenhuis et al., 2015, Peter & de Vreese, 2003). Ranging from 0 to 1, entropy allows for more valid comparisons across diversity types and communication platforms. Both categorical and relative diversity were computed for (1) all framing elements, (2) diagnostic frames, and (3) prognostic frames. Correspondingly, for the actors we computed (1) general actor diversity based on the coding of actor appearance, (2) diagnostic actor diversity based on the attribution of cause responsibility, and (3) prognostic responsibility based on the attribution of solution responsibility.

Importantly, diversity was not calculated per post or article because this would yield measures that are strongly dependent on the nature of each medium, with longer news articles potentially containing a larger number of frames and actors (see Masini et al., 2018). Instead, we aggregated the number of occurrences of each frame element and actor type to the week level for each medium type and calculated diversity per medium based on these weekly aggregates. Categorical diversity was then computed by counting the number of distinct (diagnostic/prognostic) frames and actors occurring in a week. The standardized H-statistic was calculated as entropy score for relative diversity by using the following equation:

$$H = \frac{-\sum_i^k p_i \ln p_i}{\ln k}$$

By taking the maximum number of categories for each diversity type into account, the scores of relative diversity can range from 0 (only one category represented) to 1 (all available categories represented).

## Results

### ***Comparing Diversity Categories Across Platforms***

We first compared the average scores of the different diversity categories across media channels (see Table 1). Overall, we found higher degrees of categorical and relative diversity for newspaper articles compared with tweets, with the exception of diagnostic actor diversity. Thus, specifically, the discussion surrounding the definition, origin, and possible causation of the issue involved a greater diversity of actors on Twitter compared with news coverage. All other aspects of the debate, in contrast, were consistently reported with greater diversity in terms of frames and actors by the news media.

Zooming in into the distinct framing elements and actor types that were represented revealed interesting differences across platforms (see Table A1 and Table A2). Because of their different nature and, specifically, differences in length, frames and to a lesser extent responsibility attributions appeared more frequently in news articles compared with tweets. In addition to the presence of the problem, regulation and supervision issues and health-related consequences were among the most frequently used diagnostic frames on both platforms. The usage of pesticides, in contrast, was one of the dominant diagnostic frames in the media that was less relevant on Twitter. Similarly, on the prognostic side, regulative solutions ranked first on both platforms followed by the removal of animals and product recalls.

Clear responsibility attributions to specific actors were relatively rarely made on both platforms. Although fipronil-related actors were mostly held responsible for the problem in news articles followed by authorities and political actors, authorities were most often mentioned in tweets followed by industry, political, and fipronil-related actors. Concerning prognostic responsibility, authorities were mentioned most in news articles followed by industry and politics. The latter two were also most present in the tweets while authorities only played a very minor role.

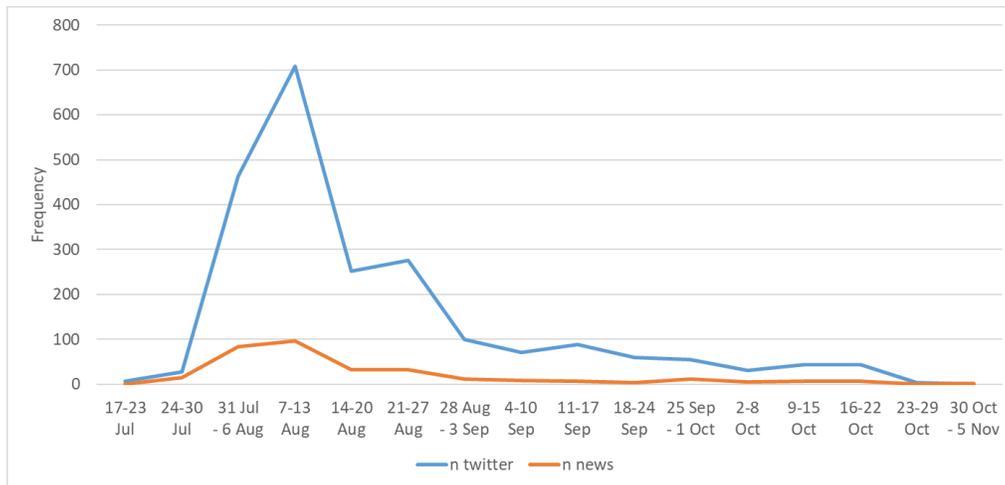
**Table 1. Means (and Standard Deviations) of Average Diversity per Medium and Diversity Type.**

Diversity Type	Newspaper		Twitter		Total	
Categorical frame diversity	12.50	(5.40)	9.93	(5.40)	11.17	(5.37)
Categorical diagnostic frame diversity	7.50	(3.13)	6.07	(3.13)	6.76	(3.10)
Categorical prognostic frame diversity	5.00	(2.64)	3.87	(2.64)	4.41	(2.54)
Categorical actor diversity	7.57	(2.49)	6.93	(2.49)	7.24	(2.13)
Categorical diagnostic actor diversity	2.43	(2.19)	3.33	(2.19)	2.90	(2.14)
Categorical prognostic actor diversity	2.86	(2.22)	1.93	(2.22)	2.38	(2.31)
Relative frame diversity	0.71	(0.19)	0.53	(0.19)	0.61	(0.19)
Relative diagnostic frame diversity	0.68	(0.22)	0.47	(0.22)	0.57	(0.23)
Relative prognostic frame diversity	0.56	(0.31)	0.38	(0.31)	0.47	(0.28)
Relative actor diversity	0.79	(0.20)	0.70	(0.20)	0.74	(0.17)
Relative diagnostic actor diversity	0.27	(0.25)	0.41	(0.25)	0.35	(0.27)
Relative prognostic actor diversity	0.31	(0.29)	0.21	(0.29)	0.26	(0.30)
<i>N</i>		318		2,224		2,542

### **Issue Attention Over Time**

To better understand the dynamics of the debate, it was important to first consider the overall amount of attention paid to the issue throughout the research period. Figure 1 shows that—taking the different nature of tweets and news articles into account—the course of the debate was rather similar on both platforms, with an increase in attention over the first three to four weeks followed by a first steeper and then more gradual decline. As can be expected from a relatively specific and narrow issue, the highest attention levels did not last very long, followed by a longer tail of relatively low levels during which other, competing issues may have increased in relevance.

To contextualize these findings, we elaborate on the peak moments in Figure 1, based on the content of the sampled tweets and newspaper articles. By the end of July 2017, the Netherlands Food and Consumer Product Safety Authority (NVWA, 2017) announced that the organization was investigating the use of fipronil in the poultry sector. In addition to that, the organization also recalled eggs from resellers and some poultry farms were “blocked” by the authority. This investigation was triggered by the discovery of fipronil in Belgian eggs. Figure 1 shows a clear run-up to an attention peak in week 32 (second week of August 2017), when newspapers started to report about the NVWA decisions. Soon after that, the debate unfolded. Responsibility was mainly attributed toward the company that produced the pesticide, mixing legal pesticides with the banned pesticide fipronil, and the company that resold and applied it. Three years later, it turned out that the reselling company knew their pesticide contained fipronil, and this reseller was therefore held responsible for the claims of the poultry farms.

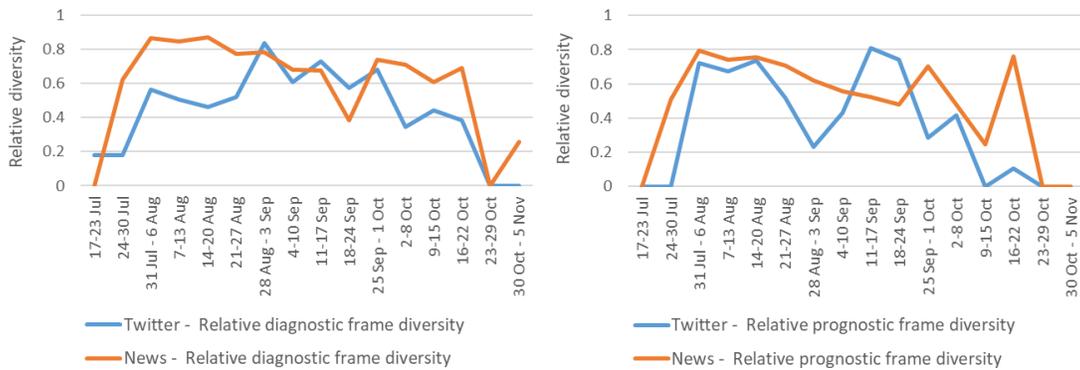


**Figure 1. Frequency of sampled tweets and newspaper articles per week (in 2017).**

Coverage in August 2017 mainly focused on making sense of the issue: discussing responsibilities of regulators and the companies that applied the pesticides, (financial) implications for involved actors such as poultry farmers, and health consequences for consumers. The main topics were whether the NVWA neglected previous warnings and whether the organization functions appropriately, in addition to the political debate about this issue as the Parliament interrupted its summer recess, the financial implications for poultry farmers and the “egg sector,” and food safety for consumers. Moreover, the directors of the reselling company were arrested. After early September, the volume of attention strongly decreased.

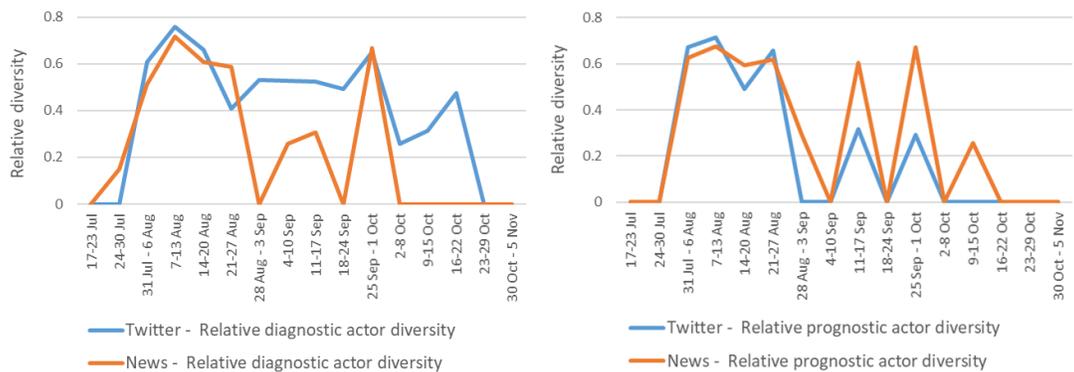
### ***Frame and Actor Diversity Over Time***

As a next step, we assessed the different diversity types over time. To allow for a better comparison across platforms when assessing the dynamic of frame and actor diversity, we focused on the relative diversity measures only. However, it should be noted that the findings look rather similar for categorical diversity. Figure 2 displays how the relative diversity of diagnostic and prognostic frames developed over the 16 weeks. At first glance, the overall trends appeared quite similar across platforms and frame types with a stark increase during the first two weeks and a decrease toward the end. Our results showed an issue cycle during which competing viewpoints get introduced first and the debate gradually moves toward an agreement in the form of a dominant definition and solution of a problem. However, both the diagnostic and prognostic side of the debate were characterized by fluctuations. Intermediate low points of diversity may point to phases during which the carrying capacity of specific frames was “tested” before new arguments or events trigger higher levels of diversity. Such fluctuations were more pronounced on Twitter with a greater number of peaks and steeper slopes as compared with more continuous news coverage.



**Figure 2. Relative frame diversity types per platform and week (in 2017).**

Figure 3 shows the development of actor diversity over time. Corresponding to the generally lower degree of presence of responsibility attributions, we can observe greater fluctuations. Specifically, in the news coverage, responsibilities were hardly discussed at certain times during the debate, whereas especially diagnostic responsibility was present on Twitter throughout the 16 weeks. Nonetheless, the curves were strikingly similar between platforms for both diagnostic and prognostic responsibilities indicating a strong overlap between both media agendas over time. Hence, while according to the trends of frame diversity, specifically, the discussion of solutions seemed to differ between Twitter and newspapers, the high similarity in terms of prognostic actor diversity rather indicates parallels of the discussions. Looking at the final phase is particularly revealing because for both frames and actors, an agreement seemed to have been reached yielding a dominant perspective in Twitter at an earlier stage than in the news coverage.



**Figure 3. Relative actor diversity types per platform and week (in 2017).**

Examining the frequency plots of individual actors and frames over time offered additional insights on the nature of these diversity dynamics. The most relevant diagnostic frames appeared in a rather similar fashion of Twitter and in the news, reflecting the general attention curve of the issue. Interestingly, partly different priorities could be observed, with health concerns, for instance, receiving higher attention levels in the news compared with Twitter in weeks 31 and 32, whereas problems of

regulation and supervision received greater attention on Twitter over a longer period from week 32 to 38. Concerning solutions, we observed varying priorities over time across platforms. Attention for product recalls was higher at first in the news, but it became a more prevalent frame on Twitter later. Similarly, regulative solutions were more strongly discussed on Twitter during weeks in which this frame received less attention in the news. The differences in actor responsibility levels between platforms reflected these priority shifts of the most prevalent frames, for instance, with authorities and industry actors receiving more attention over longer periods of time on Twitter, whereas fewer differences were found for the attention for political actors.

### **Conclusion and Discussion**

Content diversity is a key concept that has been used to assess the quality of journalism and its democratic value in traditional offline and online media (Hendrickx et al., 2022; Joris et al., 2020; Loecherbach et al., 2020). With the expansion of public discourses to user-generated platforms, we have argued that content diversity may be applied more generally to assess the quality of public discourses across platforms.

To compare content diversity between newspapers and Twitter, we have developed a framework for studying intraissue diversity based on a set of nuanced diversity measures that can be used to describe and compare issue arenas over time (Luoma-aho & Vos, 2010). Specifically, by building on studies that have measured and compared actor and viewpoint diversity across newspapers or across online and traditional news (Humprecht & Esser, 2018; Masini et al., 2018), we propose diversity measures that take representative and discursive aspects of content diversity into account. We build on the theory of social movement frames (Ketelaars, 2016; Snow & Benford, 1988) and discern diversity of diagnostic and prognostic aspects of a debate by comparing the diversity of frames and actors on these two dimensions. We thus add to previous research by not just comparing news media and user-generated content but also looking into the dynamics of actor and frame diversity in more detail.

Comparing content diversity between traditional news media and social media allows us to draw conclusions about possible consequences of a journalistic versus a user-centric production context (Hendrickx et al., 2022). Concerning the liberal, representative aspect of content diversity, our results indicate that there were overall higher diversity levels in the newspaper articles compared with tweets, except for diagnostic actor diversity. This may seem surprising considering the democratic potential oftentimes attached to online platforms such as Twitter is more open to multiple viewpoints, circumventing journalistic selection routines and thus potentially being able to offer greater diversity in public debates (e.g., Papacharissi, 2002; Schäfer, 2016). Previous studies have pointed to limitations of the democratic and inclusive potential of social media and Twitter more specifically (e.g., Bozdag et al., 2014; Liu & Weber, 2014). So has content diversity on Twitter been found to be limited concerning minority voices (Bozdag et al., 2014). However, other research has identified a greater diversity of social media when it comes to niche issues and related actors and their viewpoints (Rogstad, 2016).

Content diversity in traditional news media might be threatened by aspects related to the media market, such as increasingly competitive markets and decreasing ownership diversity (Hendrickx & Van

Remoortere, 2021; Humprecht & Büchel, 2013), but journalistic norms such as objectivity and fairness seem to remain vital mechanisms safeguarding the diversity of represented actors and frames (Hendrickx et al., 2022; Kim & Kwak, 2017). On a macro level, factors including a multiparty system and a strong status of public media as they are present in the Netherlands have previously been identified as favorable for higher levels of journalistic content diversity (Humprecht & Esser, 2018). Although the present study lacks comparison across countries and does not allow such conclusions, these macro aspects might help to explain why we find overall high diversity levels on both platforms. Finally, it is important to point to an increasing interlinkage between media platforms, which has not been assessed by the current study (Hendrickx et al., 2022). Research findings indicate that social media may follow traditional news coverage in their representation of debates (van den Heijkant et al., 2019) or vice versa (Harder et al., 2017).

In light of such interlinkages, it is important to consider the distinct roles of platforms in public spheres. Looking at the discursive or deliberative process, and hence focusing on the dynamics of the debate, points to partly different functions and therefore complementary roles of both platforms for public discourses. In line with earlier findings on frame alignment during crises (Gerken & van der Meer, 2019; Hellsten & Vasileiadou, 2015; van der Meer et al., 2014), our results show an issue cycle during which competing viewpoints get introduced first and the debate moves toward an agreement in the form of a dominant definition and solution of a problem at later stages of the debate, pointing toward a reached consensus (Dahlgren, 2005; Patriotta et al., 2011). Overall, dynamic actor and frame diversity patterns were quite similar in Twitter messages and newspaper content. However, the similarity of diversity patterns over time vanished once we distinguished between diagnostic and prognostic actor and frame diversity with different peaks and, specifically, with stronger fluctuations observed on Twitter. These fluctuations point to a more dynamic nature of this medium, which is less bound to journalistic routines and selection criteria. Hence, although not presenting a greater diversity of viewpoints, Twitter may offer a greater sensitivity toward unexpected turns in a debate. In addition, comparing dynamics of specific frames indicated that Twitter offers possibilities for continued or prolonged discussion on subissues as opposed to shorter attention spans in the news. Twitter more strongly serves as a platform for representative diversity as opposed to negotiation toward solutions (Rogstad, 2016). In contrast, a stronger focus on prognostic frames and responsibilities during later stages in the news articles, hence shifting from the problem to solutions, is in line with journalistic norms and practices and underlines the constructive role of journalism in public debates (Aitamurto & Varma, 2018).

As a next step, it could be interesting to see how issue-specific diversity compares across issues. The issue of fipronil can be considered a punctuated, short-range issue as opposed to larger, more controversial or politicized issues. It is an instance of an event that regularly takes place in societies: organizational irregularities that possibly impact public health and thus lead to public concern and discussion. Therefore, we can expect that the dynamics and platform roles identified here may apply to other midrange issues as well. The differentiated function of journalistic and user-generated content identified here may be even more pronounced for issues that show greater levels of controversy and that include a broader range of actors and viewpoints from the outset (Benson, 2009). Hence, future research should assess to what extent greater levels of content diversity are associated with differences in the dynamics leading to agreement on possible solutions and responsibilities.

In sum, our findings suggest that newspapers offer greater overall levels of content diversity and seem—for the specific case studied here—to exceed Twitter in the liberal ideal of representing a broad range of actors and viewpoints. When it comes to the deliberative aspect of how different viewpoints and responsibilities are negotiated, the dynamics on Twitter appeared more flexible, offering a fruitful supplementary platform for public deliberation with a greater openness and accessibility compared with journalistic news formats whereas the latter more clearly contributed to the construction of agreement and findings consensus on solutions and prognostic responsibilities. Concerning the agonistic potential of Twitter and newspapers to unfold and challenge existing power imbalances, our research design offers rather limited insights and needs to be further expanded to more fully compare discursive practices across platforms.

From a methodological point of view, it is important to ensure comparability of diversity scores across media platforms. We did this by aggregating the data and calculating diversity on the week level to avoid biases that might occur because of medium-specific differences such as the length of tweets and news articles and the absolute numbers of items. In follow-up studies, the effect of different levels of aggregation of the data (weekly, monthly, etc.) can be systematically compared for consistency of results. Another potential avenue of further research could combine sociosemantic network analysis (Hellsten et al., 2019; Roth, 2013) that connects the content of communications with the mentioned actors.

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## Appendix

**Table A1. Relative Frequencies of Framing Elements per Platform.**

Framing Elements	ICR Score*	Newspaper	Twitter	Total
Diagnostic				
Fipronil presence	0.406 / (.941)	67.6	34.4	38.6
Production methods of pesticides	0.907	12.3	1.1	2.5
Selling methods of pesticides	0.514 / (.903)	13.2	1.4	2.9
Use of pesticides	0.751	40.9	2.4	7.2
Animal welfare	- / (.752)	6.6	0.2	1.0
(Financial) damage	0.859	34.3	2.7	6.6
Selling poisoned eggs	0.874	13.5	1.9	3.4
Regulation and supervision	0.670 / (.883)	37.7	8.3	12.0
(Public and individual) health	0.867	37.7	6.3	10.2
Consumer behavior	-	0.6	0.0	0.1
Economic considerations	1.000	5.7	0.4	1.0
Ethical considerations	1.000	4.1	1.2	1.6
Prognostic				
Production methods of pesticides	-	0.9	0.0	0.2
Selling methods of pesticides	-	0.3	0.0	0.0
Kill poultry	1.000	23.6	2.8	5.4
Remove eggs	0.921	13.2	0.6	2.2
Animal-friendly solutions	0.851	10.1	1.7	2.8
Recall egg-related products	0.971	18.9	3.3	5.3
Regulative solutions	0.697	47.2	7.5	12.4
Change consumer behavior	0.855	7.9	0.4	1.3
Mobilization of citizens	0.747	1.3	0.4	0.6
Warning for consumers	0.896	15.7	1.2	3.0

*Note.*  $N = 318$  articles + 2,224 tweets. \* Krippendorff's alpha based on  $n = 252$ . No intercoder reliability (ICR) scores of frames were absent in ICR sample (and presence of <1% in full sample). ICR scores in brackets based on additional sample for original ICR < .7.

**Table A2. Relative Frequencies (%) of Diagnostic and Prognostic Actor References per Platform.**

	Diagnostic Responsibility		Prognostic Responsibility	
	Newspaper	Twitter	Newspaper	Twitter
None	81.4	93.1	86.2	96.7
Citizens	0.1	0.0	0.4	0.1
Politics	3.6	1.4	3.3	1.3
Authority	5.1	2.6	5.5	0.5
Fipronil related	6.8	1.3	0.2	0.0
Other industry	2.8	1.4	4.0	1.1
Finances	0.0	0.0	0.0	0.2
Sciences	0.0	0.0	0.1	0.0
Other	0.2	0.2	0.3	0.1
Total	100.00	100.00	100.00	100.00

Note. Sample consists of  $N = 318$  articles and  $N = 2,224$  tweets.