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Active and passive stakeholders in issue arenas: A communication network approach to the bird flu debate on Twitter

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ABSTRACT

Issue arenas, as places for societal discussions, have recently been studied as an important aspect of organizational environments. While a fundamental part of any issue arena is the distinction between active and passive actors, empirical analyses have mainly focused on active stakeholders. We approach issue arenas as communication networks in which active stakeholders discuss topics and involve passive stakeholders. Based on network theory, we introduce an automated method for mapping these issue arenas on Twitter. In particular, we combine manual coding of active stakeholders, and automated semantic network analysis of addressed, passive stakeholders and their topics of discussion. Empirically, we focus on the issue of bird flu affecting poultry farming in the Netherlands from 2015 to 2017 with a sample of 704 Twitter messages. Instead of pre-defining a set of stakeholders for the analysis, our approach to study communication networks in online settings allows for mapping issue arenas based on the stakeholders that communicate about the topic.

1. Introduction

Communication between organizations' stakeholders increasingly takes place via social media platforms such as Twitter, where various actors can participate in the debate over issues in which they have a stake. Consequently, organizations operate in complex, dynamic environments in which several issues are present simultaneously, initiated and discussed by different stakeholders and other actors. Because this development challenges organization-centered approaches of stakeholder management (Donaldson & Preston, 1995; Fassin, 2009), Luoma-aho and Vos (2009) have proposed issue arenas as a concept focusing on the societal matters that connect different actors, outside the organization's control, but with the ability to affect its legitimacy (Luoma-aho & Vos, 2010). Issue arenas are defined as places where stakeholders and organizations discuss societal issues (Luoma-aho & Vos, 2010). The concept of issue arenas adds a substantive aspect to the relation between organizations and their publics. Societal issues, as opposed to organizations, are regarded as organizing elements for the relationship between organizations and their stakeholders. Organizations operate in networks of multiple issue arenas where different (groups of) stakeholders may participate in one or several issue arenas.

While Luoma-aho and Vos (2010) have stressed that actors may be active or passive, empirical analyses of issue arenas have mainly focused on active stakeholders (Luoma-aho, Tirkkonen, & Vos, 2013; Zhang, Vos, Veijalainen, Wang, & Kotkov, 2016). From an agency perspective, authors on Twitter can be considered as active stakeholders who have will and creativity to bring about societal change regarding the issue at stake (Dorado, 2005), also by addressing other actors who may remain passive in the debate. In this way, we also relate to debates on the position of inactive publics, which are mainly discussed in theoretical terms (e.g. in the

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situational theory of publics), but did not receive much empirical attention in public relations. Grunig and Hunt identify latent publics, who are affected by the organization and therefore are linked to it (Grunig & Hunt, cited in: Dozier & Grunig et al., 1992). Hallahan (2000) explains that “inactive publics largely meet the definition of stakeholders, but no assumption is necessarily made that they recognize their stakeholder role” (p. 501). Applied to issue arenas, inactive publics are characterized by groups of individuals that have low levels of knowledge about the issue and exhibit low levels of involvement in it. They are different from non-publics that have no knowledge or involvement (Hallahan, 2000). Publics can move from an inactive or passive position to an active one, for example as a consequence of media coverage. An empirical account of passive, inactive publics in addition to active stakeholders is an important addition to current issue arena approaches. Therefore, we consider issue arenas as communication networks that involve, first, stakeholders as active and passive participants (Luoma-aho & Vos, 2010). As active participants, stakeholders write and send, i.e. ‘author’ messages to other stakeholders. As passive participants, stakeholders are mentioned and addressed in the messages (e.g., Luoma-aho et al., 2013; Zhang et al., 2016). Second, within these communication networks, the topics that the stakeholders discuss serve as organizing principles. On Twitter, for example, stakeholders have the option to tag their messages into broader topics using a #hashtag (for example #birdflu) in the message content. Hashtags allow for other Twitter users to search for tweets on a specific topic. At the same time, hashtags can be understood as semantic organizing principles within issue arenas.

In sum, our aim is to extend current issue arena approaches, and provide an automated communication network approach for mapping active and passive actors in issue arenas. To analyze both active stakeholders as authors, and passive stakeholders as addressees, we combine the results of the automated network analysis with manual coding of the authoring stakeholder groups. The communication network approach advances empirical research of issue arenas by developing a bottom-up, systematic analysis of stakeholders in active and passive roles and the topics that are discussed in an issue arena.

Substantially, we focus on the Twitter debate on bird flu affecting poultry farming in the Netherlands as a recent, unintended food safety issue. The responsibility cannot be attributed to a single organization or group of actors, but its nature (food safety that is linked to public health) leads to the involvement of many actor groups, such as poultry farmers, regulators, and citizens (Coombs, 2007). Twitter is known to be used for the dissemination and discussion of information concerning public health issues and is a popular social medium in the Netherlands (Grimmelikhuijsen & Meijer, 2015; Sinnenberg et al., 2017). We analyze two years of Twitter content, from 2015 to 2017. Our results show the development of the debate over time as well as the authors, addressed actors, and topics that construct the overall communication network around this issue. We end with the discussion of the implications of the communication network approach for advancing the concept of issue arena, and propose further research into the dynamics of issue arenas as communication networks.

2. Literature review

2.1. Actor positions in issue arenas

Previous research on issue arenas shares a common observation: new communication technologies have enabled stakeholders to communicate more directly at the expense of the organization’s core position and communicative control (Luoma-aho & Vos, 2009; Vos, Schoemaker, & Luoma-aho, 2014). Issue arenas can differ in various ways, such as topic, impact, duration of the discussion, and the number and type of actors involved. Examples are equal payment, public health, #MeToo movement, but also the global climate challenge and local topics could come up as an issue. Issues are not necessarily ‘owned’, but several actors (among them organizations) are a discussing party in an issue arena (Luoma-aho & Vos, 2010).

Acknowledging that, specifically, organizations may decide to remain a bystander or observer in an issue arena and not to get actively involved in the debate. This is a crucial shift when compared to traditional stakeholder models that regard the organization as central and in control of its environment (Donaldson & Preston, 1995; Fassin, 2009). Accordingly, the distinction between active and passive actors has been formulated as one of the central axioms guiding future research into issue arenas (Luoma-aho & Vos, 2010).

From an agency perspective, active stakeholders are those who have will and creativity to bring about societal change regarding the issue at stake as opposed to passive actors who may be addressed but do not actively participate in the debate (Dorado, 2015). Passive actors have been previously conceptualized as ‘latent publics’, as part of public relations perspectives on the role of publics, such as the situational theory of publics (Grunig & Hunt, discussed in: Dozier & Grunig et al., 1992; Kim, Ni, & Sha, 2008). Latent publics are different from active publics, who communicate about an issue and, consequently, organize themselves to act upon it. Aware publics differ from active ones in not communicating about the issue although they are conscious of it. In contrast, if a group of people is affected by organizational actions but is not aware of that, it is characterized as latent public (Grunig & Hunt, discussed in: Dozier & Grunig et al., 1992). These segmentations are situational: they depend on organizational issues and consequences (Kim, Hung-Baesecke, Yang, & Grunig, 2013).

Successors of the situational theory of publics also reflected on latent/inactive publics or, as we call it, passive stakeholders. Hallahan (2000) distinguishes between the level of involvement (high or low) and the level of knowledge (high or low) to discern between various types of publics. He considers publics with both low levels of involvement and low levels of knowledge as ‘inactive’, which is different from being a non-public (no knowledge, no involvement). The situational theory of problem-solving recognizes latent publics as “people who face the problem but are not aware of it” (Lee, Oshita, Oh, & Hove, 2014, p. 189) and is an extension of the situational theory of publics that aims at explaining communicative action (Kim & Grunig, 2011). Most empirical research in this field concerns transformations: how can latent publics become aware or active and what is the role of corporate communication in

that process (D'Urso, 2018)? In contrast, we focus on the preceding stage of identifying passive stakeholders and describing their role in issue arenas.

Previous research on issue arenas has mainly focused on active stakeholders. Empirical studies have positioned the issue at stake as central and focused on four inter-related aspects as outlined by Vos et al. (2014): First, the issue itself and its boundaries are defined. Second, the actors involved as stakeholders in the debate are identified. Third, the place where the communication between the actors takes place is delineated, for example, news media or social media platforms, and fourth, the course of the debate over time is analyzed. Issue arenas have been analyzed in two different ways. The first approach follows one of the most central ideas of the concept of issue arena taking the issue as starting point. For example, Luoma-aho et al. (2013) have analyzed the 2009 swine flu episode in Finland based on organizational press releases and citizen discussions on online forums (see also Tirkkonen & Luoma-aho, 2011). Contrasting organizational information and responses of citizens revealed the role of emotions for the course of the swine flu debate (Luoma-aho et al., 2013). The issue of the Dieselgate scandal has been analyzed using Twitter data (Zhang et al., 2016). Automated analysis tools allowed to describe changes in the scope of the debate over time, the development of sentiments over time, and to identify the most active actors and topics (Zhang et al., 2016). A second approach takes organizations as a starting point to identify multiple relevant issue arenas. This has been done for the issue of human trafficking (Meriläinen & Vos, 2015). While providing a comprehensive overview of the dynamics of issue arenas, other aspects, such as the importance of specific actors or also links between different actor types remain hidden in these previous studies.

2.2. Issue arenas as communication networks

Issue arenas can be described as communication networks in which active stakeholders discuss topics and involve passive stakeholders. Stakeholders as active 'authors' are assumed to participate in issue arenas which offer them the possibility to put topics on the agenda, to initiate societal change, and to mobilize other actors. In this process, they address other stakeholders, in connection to their topics. Dependent on their position in the network, their resources, and motivations, active stakeholders can employ several strategies that foster their goals (Dorado, 2005; Stevenson & Greenberg, 2000). Organizations participating in the debate may actively engage in interpreting and reformulating the issue at stake because it may affect the organization's legitimacy (Frandsen & Johansen, 2013).

Differentiated views on actor positions discerning different roles or activity levels can be found in research on stakeholder-stakeholder interactions and organization-stakeholder interactions (e.g., Sedereviciute & Valentini, 2011). Mariconda and Lurati (2015), for example, have assessed the mutual influence of various stakeholder groups and constructed social networks describing how various issues influence each other according to stakeholder perceptions. Valentini, Romenti, and Kruckeberg (2016), in turn, discussed rhetorical arenas conceptually focusing on the communicative interactions among the actors.

To integrate the concept of issue arenas with these previous accounts of stakeholder interactions, we take the issue as a starting point and add the substance of interaction (thus, the semantic content of the issue) to these social networks. To take a full account of both the relations and the substance of the interaction, our focus is on combining social network analysis with semantic network analysis. Network theory, in general, has been developed along two lines, the first one focusing on relations between actors (social networks), and the second one analyzing the relations between words in the content of the communication (semantic networks), and recently socio-semantic network approach has been proposed (Roth, 2013) for combining the social and semantic networks. We detail out each of these network approaches below.

2.2.1. Social network analysis

In social network analysis (SNA), actors are the nodes, and the relations between the actors form the links, also called edges, in the network (Borgatti & Foster, 2003). Social network analysis often aims at finding the most important actors in the network – defined as the most central actors in terms of degree centrality, or in terms of connecting other actors in terms of betweenness centrality (Wasserman & Faust, 1994).

In the context of public relations research, social network analysis has been applied to detect communities of connected actors (e.g. Himelboim, Golan, Moon, & Suto, 2014). SNA is widely used also for the analysis of social media data. For example, Himelboim, Smith, Rainie, Shneiderman, and Espina (2017) mapped the social networks of Twitter debates around specific hashtags and found six different social network typologies according to the level of density (closeness of the actors) and modularity (clustering of the actors) in the networks of Twitter users. SNA focuses on the relation between active actors who often form reciprocal ties with each other.

2.2.2. Semantic network analysis

In semantic network analysis, words used in the messages are considered nodes and their co-occurrences form links between these nodes (Carley & Kaufer, 1993; Diesner, 2013; Leydesdorff & Hellsten, 2005). Such content dynamics have been mapped in terms of patterns of co-occurring words (Danowski, 2012; Leydesdorff & Hellsten, 2005) and topic detection of clusters in word co-occurrence networks (e.g., Carley & Kaufer, 1993; Danowski, 2012; Diesner, 2013).

In public relations research, semantic network analysis has been used for analyzing frames and word associations. Schultz, Kleinnijenhuis, Oegema, Utz, and van Atteveld (2012), for example analyzed the associative crisis response frames in the BP crisis using a semi-automated semantic network approach, while Golob et al. (in-press) applied semantic network analysis to compare the associations attached to corporate social responsibility in two European countries. The semantic network approach (Hellsten, Dawson, & Leydesdorff, 2010) has been further developed for measuring frame alignment between traditional media, social media,

and organizational communication (Van der Meer, Verhoeven, Beentjes, & Vliegthart, 2014).

2.2.3. Socio-semantic networks

Recently, social networks of actors and the semantic networks of their communications have been combined into what Roth and Cointet (2010) call socio-semantic networks. In a study on academic publications, Roth (2013) proposed that whereas the authors of the publications form social network ties with their co-authors, the topics of the publications form semantic networks. Combining the networks of authors and the networks of their topics results in socio-semantic networks. We apply the idea of socio-semantic networks to Twitter, and map the networks of active stakeholders (authors) mentioning passive actors (addressees) as social networks, and the co-occurring addressees and hashtags as a semantic network, and combine these two into socio-semantic networks of active stakeholders addressing other actors and topics. This socio-semantic perspective builds upon actor-network theory (Latour, 1996) that considers both humans (e.g., authors and addressees) and non-humans (e.g., hashtags) as having agency in the network.

2.3. Twitter and issue arenas

Our focus is on Twitter as a social medium. Out of all social media, Twitter has gained relevance as a medium to discuss political topics, in particular. The content on Twitter is characterized by unidirectional (non-reciprocal) connections, which stimulates the spread of information beyond personal networks, making it also a suitable tool for organizational communication (Van Zoonen, Verhoeven, & Vliegthart, 2016). In public relations, Twitter has been analyzed for its potential for enhancing stakeholder interactions (e.g., Lovejoy, Waters, & Saxton, 2012).

Social media usage in the Netherlands is high and Twitter can be considered as a major platform in the period under study (Grimmelikhuijsen & Meijer, 2015). Although Twitter usage has decreased over the years, around 2.8 million people in the Netherlands (of the approximately 17 million inhabitants) used Twitter between 2015 and 2017 and around one million users did so on a daily basis (Newcom Research and Consultancy, via Marketingfacts, 2015, 2017). The Netherlands belongs to the top ten countries with the highest Twitter penetration rates in the world (Peerreach.com, 2013). Online social media discussions can however not be considered as an exact reflection of societal discussions, as users and their views are not representative of the society at large. In addition, the views expressed on social media are affected by platform-specific constraints (e.g., tweets of max. 140 characters in our research period) and norms (Ruths & Pfeffer, 2014).

Twitter data enable us to study the relations between those authoring tweets and those actors addressed in the tweets (social network analysis). Building upon the concept of issue arenas, we also focus on the relations between the addressed actors and topics in the content of the tweets (semantic networks). Finally, all three elements of stakeholders authoring Twitter messages and addressing other actors and topics can be combined into communication networks that represent an entire issue arena. The mapping of the issue arena is constituted by two factors. From a relational perspective, actors can vary in their roles throughout the debate: they can be authors (active) and addressees (passive) simultaneously and subsequently. In addition, authors can start, join, modify, and relocate the debate with a reference to other actors. The second factor is related to the substance of the interaction. The authors can introduce new topics related to the issue, for example, by using other hashtags and utterances, thus modifying the content of the debate. In this way, sub-arenas can emerge in the initial issue arena.

Fig. 1 summarizes the proposed communication network approach and the related three types of network analyses. The right side of the figure, within the dashed line square, represents the content of tweets. The lower side in Fig. 1 covers social networks of (active) stakeholders mentioning other, passive users (addressees) in their Twitter messages. Socio-semantic networks of (active) stakeholders mentioning hashtags in their Twitter messages are represented in the upper side in Fig. 1, and finally, the semantic networks of co-mentioned addressees and hashtags are located on the right-hand side in Fig. 1. Fig. 1 as a whole covers the entire communication network that constitutes an issue arena consisting of active stakeholders (authors), passive addressees (addressed actors) and topics. Read from left-to-right, the figure reflects our focus on both humans (authors and addressees) and non-humans (hashtags) as equally important elements of issue arenas.

Applying the communication network approach to the bird flu issue arena on Twitter, our research questions are:

RQ1: Who are the main stakeholders who authored Twitter messages, and how does their presence develop over time?

RQ2: What are the main topics addressed in the arena, and how does their relevance develop over time?

RQ3: Who are main addressees mentioned in the Twitter messages, and how does their presence develop over time?

Fig. 1. The communication network of issue arenas: Social, socio-semantic, and semantic networks of stakeholders authoring messages, using hashtags, and mentioning addressees.

- RQ4: Which topics and addressees co-occur in the Twitter messages sent by the active stakeholders (as authors) in the issue arena?
 RQ4a: Who do the stakeholders (as authors) address in their Twitter messages?
 RQ4b: Which topics and addressees co-occur in the Twitter messages?
 RQ4c: Which topics are mentioned by which active stakeholders?

3. Research approach

3.1. The issue: bird flu outbreaks in the Netherlands

We chose a single case study approach to test the automated approach to mapping an issue arena of authors, addressees, and hashtags. We focused on an issue that is not clearly initiated by one organization, but qualifies as an unintended crisis that affects several types of actors. The issue of bird flu affecting poultry in the Netherlands is related to public health, animal welfare, agricultural economy, and governmental regulation and therefore likely to attract communication from several potential stakeholders such as poultry farmers, individual citizens, the mass media, governmental organizations, and environmental organizations. This context renders the bird flu case suitable for applying the proposed automated approach to issue arenas.

Bird flu, alias avian influenza, has affected poultry farming, but also occasionally caused epidemics with human infections, such as in 2005–2006 when the H5N1 avian influenza virus infected birds and spread to humans (World Health Organization, 2015). The spread of the H5N1 virus gained wide attention in newspapers and online discussion forums (Leydesdorff & Hellsten, 2006). Recently, different strands of bird flu (H7N7 in poultry farms and H5N8 in wild birds) have infected migration birds, wild birds as well as poultry farms in Europe (World Health Organization, 2015) and in the US. In the Netherlands, several epidemics of bird flu in 2015–2017 led to policy and emergency regulations, including poultry farms being forbidden to let their poultry to grass outside and transportation restrictions regarding the import of poultry from infected areas and transport of poultry for human consumption.

Bird flu as an issue is created by information dissemination about the outbreaks of the animal disease, and the regulations for containing it. Consequently, the social media debate on bird flu is characterized by fast circulation of information about new infections, and policy regulations taken to contain the spread of the infection. Multiple stakeholders are involved in the spreading of information concerning this issue.

3.2. Data collection and sampling

The data was collected using the *Coosto* software with the search terms “vogelgriep” AND “pluimvee” (birdflu and poultry) for the period between 1 July 2015 and 1 July 2017. This two year period was chosen because it contains three subsequent epidemics of bird flu in the Netherlands. *Coosto* is a commercial and widely used web monitoring tool that covers a wide range of Dutch-language social media, such as Twitter, Facebook, and blogs. *Coosto* crawls the social media on a daily basis, and archives the social media messages. Because *Coosto* uses the Twitter API, we cannot be sure about the completeness of our sample. This is a common limitation to Twitter research. Our initial search resulted in a set of 2139 Twitter messages. In research into issue arenas, two data related aspects are important: First, to have a set of actors who participate in the debate actively, and second, to remove messages that are not relevant to the issue. To comply with both criteria, we first compiled a sample of active actors who sent at least three tweets during the research period. We argue that these actors can be considered active in this particular issue arena while sporadic users – those who sent only one or two tweets in two years – were excluded from further analysis. The feasibility of the manual content analysis as well as the clarity of the network analysis are additional reasons for setting this threshold. This resulted in 805 Twitter messages. Thereafter, we manually checked the data set and removed non-relevant Twitter messages, that is, messages where bird flu was just mentioned while the rest of the tweet dealt with other issues. This resulted in a sample of 704 tweets. Our data include re-tweets as indicated with RT at the beginning of the twitter message. The re-tweets were included because they may increase the influence of the tweets and shed light on diversity of actors participating in the debate (Albu & Etter, 2016).

3.3. Manual coding of active stakeholders

We manually coded the 122 Twitter users, who authored three or more tweets about the issue, and classified the users into eight stakeholder groups that were expected to be relevant stakeholders in the bird flu issue: Environmental organizations, conventional industry (industrial agriculture farmers and other actors in the industrial agriculture), eco (organic) industry, media, individual citizens, political actors, public organizations, and other actors that did not fall in these categories (see Table 1). Also suspended accounts, as potential bots, were coded into the category ‘other’. The coding of stakeholder groups was based on the Twitter user accounts. In addition, we also used website links if these were present in the author’s Twitter biography. After several rounds of coder training and adjustments of the codebook, inter-coder agreement was assessed based on a randomly selected sub-sample of $n = 23$ (19% of the total author sample). Coder agreement was reached for 78.3% of the cases which resulted in a Krippendorff’s nominal α of 0.74 reflecting a modest level of inter-coder reliability.

3.4. Automated network analysis

For the analysis of the Twitter message content, we applied an automated network analysis to examine the co-occurrences of @username (passive addressees) and #hashtag (topic) networks. The tool is online available, and free for academic use (Hellsten &

Table 1

Number of tweets, authors, hashtags, and addressees in Twitter messages on bird flu and poultry per stakeholder group.

	Tweets	Authors	Hashtags	Addressees
Stakeholders	%	%	%	%
	(n)	(n)	(n)	(n)
Media	46.7 (329)	31.1 (38)	30.2 (48)	16.3 (24)
Citizens	19.0 (134)	25.4 (31)	22.0 (35)	28.6 (42)
Environmental organizations	10.8 (76)	9.8 (12)	10.1 (16)	17.7 (26)
Conventional industry	10.2 (72)	9.8 (12)	9.4 (15)	10.2 (15)
Eco-industry	1.6 (11)	3.3 (4)	5.7 (9)	3.4 (5)
Public organisations	4.8 (34)	10.7 (13)	6.3 (10)	8.2 (12)
Political actors	0.4 (3)	0.8 (1)	0.0 (0)	0.7 (1)
Others	6.4 (45)	9.0 (11)	16.4 (26)	15.0 (22)
Total	100.0 (704)	100.0 (122)	100.0 (159)	100.0 (147)

Leydesdorff, 2017; <https://leydesdorff.github.io/twitter>). This new automated tool was adjusted from the automated tool for mapping co-occurring words in text documents (Leydesdorff & Hellsten, 2006). This method has been previously used, for example to identify implicit frames in the debate on artificial sweeteners (Hellsten et al., 2010). Instead of applying a co-word based semantic network analysis for identifying frames, in this paper, we map the networks of active stakeholders who author messages, passive actors who are mentioned in the messages, and hashtags used by the authoring stakeholders.

The procedure is as follows. First, the data was organized into two documents: One containing each tweet as a separate row in a text document, and the second text file containing the hashtags and addressed usernames used in the tweets. To construct the file of tweet attributes (#hashtags and @usernames), we ran the open access tool *frqtw.exe* to create a word frequency list. This allowed us to separate #hashtags, @usernames, and other content words used in the Twitter messages. We then selected the @usernames and #hashtags as our variables for further analysis. Second, the data was analyzed with the open access routine *tweet.exe* to calculate the co-occurrences of the hashtags and usernames in the set of 704 Twitter messages. The *tweet.exe* routine calculates automatically an asymmetrical word-document matrix of the @usernames and #hashtags as the words, and the tweets as the documents. Third, the resulting network matrices were analyzed using the free social network analysis tool *Pajek* (De Nooy, Mrvar, & Batagelj, 2011), with the Kamada and Kawai (1989) layout algorithm. For the visualization, we exported the networks from *Pajek* to *VosViewer* (Van Eck & Waltman, 2007) and used the Newman community algorithm, available in *VosViewer*, for the lay-out and clustering of the networks.

3.5. Combining stakeholder coding and automated network analysis

We combined the results of the manual coding of the (active) authors into stakeholder groups, and the results of the automated network analysis of co-occurring hashtags and usernames. This was done manually by adding the stakeholder group name before the tweets in the text.txt file. This allows for the network visualization of which stakeholders used which hashtags and addressees together in their Twitter messages – used to answer our research questions. For reasons of readability, we show authoring stakeholders as AU: STAKEHOLDER GROUP (e.g., AU: CITIZEN), addresses as @username (e.g. @blikopener333), and hashtags as #hashtag (e.g. #vogelgriep), in the network visualizations.

We described and interpreted the results based on visual inspection of the network visualizations. The network visualizations provide a relational perspective to the issue arena and enabled us to observe the relative prominence of the @username (addressees) and the #hashtags (topics) to gain information on their co-occurrences within the issue arena. In our analysis, the relative size of the nodes represents the frequency of occurrences of that node (i.e. @username and #hashtags), and the line thickness the frequency of co-occurrence of the two nodes. Including the node size in the network visualizations reveals information about the relative prominence of each node and line.

4. Results

4.1. Creating the arena: authors, hashtags, and addressees over time

122 different Twitter users sent messages in our dataset ($N = 704$). These authors used 105 unique hashtags and addressed 89 unique usernames in their tweets. In particular, citizens were very active in addressing other actors. Both media and citizens used a high number of different hashtags (48 and 35, respectively) in their tweets (Table 1). Overall, the four most active stakeholder groups

Fig. 2. Number of Twitter messages authored by the eight active stakeholder groups in the debate on bird flu, from 1 July 2015 to 1 July 2017 ($N = 704$).

in the bird flu debate were the media, individual citizens, environmental organizations, and conventional industry. Taken together, these four groups authored almost 87% of all tweets. While 38 different media accounts sent 47% of all tweets, 31 individual citizens authored 19%, 12 different environmental organizations authored 11%, and 12 different conventional industry accounts sent 10% of all messages.

We present the development of the bird flu debate on Twitter, based on the timelines of stakeholders authoring messages (Fig. 2), the five most prominent hashtags (Fig. 3), and the five most often addressed usernames (Fig. 4). Naturally, the number of tweets per month also determines the number of authors, hashtags, and addressed usernames over time. The figures show three attention peaks that are related to three events: In November/December 2015, the highly pathogenic H5N1 virus infected poultry in France and another variant of bird flu epidemics spread in a mass poultry farm in Germany. In December 2016, bird flu was confirmed in three poultry farms in the Netherlands leading to strict regulations for poultry transportation. In April 2017, the regulations for containing the bird flu epidemics, such as keeping poultry inside the stalls, were loosened, for example, by exceptions for ecological poultry farms. The majority of the tweets during the first attention peak were authored by media and citizen stakeholders focusing on the emerging bird flu in France and the import ban. During the second attention peak, both media and individual citizens drove the attention to the issue. In the third phase, the most active stakeholders posting messages on Twitter were media, citizens, and other actors (Fig. 2).

In sum, concerning the first research question, we can conclude that the media actors prevailed in the arena, both as active stakeholders who authored tweets and as passive stakeholders addressed by others. Over time, however, other stakeholders – particularly citizens – gained relevance as drivers of the debate. Organizational stakeholders, specifically industry and environmental organizations, only played a secondary role as active authors.

Whereas the hashtags #vogelgriep (#birdflu) and #pluimvee (#poultry) prevailed during the first attention peak in December 2015, the hashtag #vogelgriep was most prominent during the second attention peak in November/December 2016 (Fig. 3). In addition, the hashtag #mvdnl (an activist Twitter account), peaked in the second attention period. The general, topical hashtags #nieuws (#news) and #griep (#flu) were also frequently used. Concerning the second research question, we can conclude that while

Fig. 3. The five most frequently used #hashtags in the debate on bird flu, from 1 July 2015 to 1 July 2017.

Fig. 4. The five most frequently addressed @usernames in the debate on bird flu, from 1 July 2015 to 1 July 2017.

the main topical hashtags were most frequently used during early stages, a greater variety of hashtags later on indicated an increasing complexity of the debate over time.

The main addressed usernames were @pluimveetweet (poultryTweet – a niche medium for poultry farmers), @favv_consument (Belgian Federal Agency for Food Safety – a consumer service), @vakbladveearts (professional magazine for veterinarians), @blikopener333 (online news site), and a conventional poultry farmer (Fig. 4). The change from the niche medium as most prominent addressee during the first peak in 2015 to the consumer service FAVV during the second attention peak in 2016 indicates that the debate expanded and in addition to more active also more passive stakeholders were involved. Concerning our third research question about the relevance of addressees, we can conclude that parallel to the diversification of topics over time, a greater diversity of actors has been addressed over time. Overall, media actors and organizational stakeholders, specifically industry and environmental organizations, were most often addressed by others. Media where also one of the most active groups of stakeholders whereas organizational stakeholders were less active and thus prevailed as passive stakeholders in the debate. The important role of media as addressees, and the frequent use of news-related hashtags confirmed the information-focused nature of this issue arena.

4.2. The arena as communication network

In the next steps, we show the results of social networks (RQ4a), the semantic networks (RQ4b) and the socio-semantic networks (RQ4c), and finally, combine these insights by presenting these elements of the issue arena as a communication network of authors, addressees, and hashtags (RQ4).

4.2.1. Social network of authors and addressees

The research question 4a addresses the social networks of authors and addressees: who do the authoring stakeholders mention in their Twitter messages? The relationships portrayed in Fig. 5 are unidirectional: Stakeholders as authors of the tweets addressing other actors in their tweets.

Overall, we found that each actor group had a unique set of addressees in addition to some overlap that was mainly constituted by general and niche media as well as industry accounts. Citizens (AU: CITIZEN) had a central position in the network as active stakeholders and mentioned a diverse range of passive addressees from several stakeholder groups. While citizens mainly addressed the same stakeholders as other active stakeholders, media (AU: MEDIA) as second most active stakeholder group mainly addressed actors not addressed by the other participants (right side of Fig. 5), such as individual citizens. Both citizens and media, however, referred to several Twitter-specific news accounts (@blikopener333 or @landbouwnieuws) as well as conventional and eco-industry accounts (@eltengina, @manderslooterik). Public organizations and citizens both addressed municipalities (@gemdeerlijk) and food safety authorities (@dnpapprovant, @favvconsument) (upper left side of Fig. 5). Environmental organizations, in turn, addressed online media that specialized in poultry (@vakbladveearts, @pluimveetweet) and other environmental organizations (@Eyes-on-Animals) (lower center in Fig. 5).

4.2.2. Socio-semantic network of authors and hashtags

Our research question 4b focused on which stakeholders used which hashtags in the bird flu issue arena. We constructed authoring stakeholder to hashtag networks (Fig. 6). In contrast to the social network of tweet authors addressing other actors – with citizens as the central stakeholder group, the media was most central as active stakeholder in the use of hashtags while the other stakeholder groups used less hashtags and were therefore situated at the periphery of the network. In particular, the issue related hashtags #vogelgriep (bird flu) and #pluimvee (poultry) were most centrally located.

4.2.3. Semantic network of hashtags and addressees

Our research question 4c focused on the co-occurring hashtags and usernames in the bird flu debate to more closely analyze the

Fig. 5. The social network of the 38 addressees co-occurring (≤ 2) in the Twitter messages authored by the eight stakeholder groups.

Fig. 6. The socio-semantic network of the 44 hashtags (≤ 2), co-occurring in the Twitter messages authored by the eight stakeholder groups.

content of the debate. In addition to the timeline of the frequencies of the top-five most frequent hashtags and addressed usernames (Figs. 3 and 4 above), the network visualization shows how the hashtags and addressed actors co-occurred in Twitter messages (Fig. 7).

Fig. 7 reveals the main hashtags #vogelgriep and #pluimvee as central for the network together with two issue-specific niche media accounts as main addressees (@pluimveetweet, @vakbladveearts). More general news-related hashtags and addressees formed a separate cluster (#nieuws, #nieuwstwitter) (on the right-side). Conventional industry was represented in the two overlapping clusters in the lower center (#pluimveebedrijf or @boerderij.nl) and thus independent from one of the main regulations for the epidemics containment (#ophokplicht – referring to keeping poultry inside the stalls) which formed its own cluster (upper side, center).

Fig. 7. Semantic network of co-occurring 44 hashtags and 38 addressed usernames (≤ 2) in the 704 Twitter messages on bird flu and poultry.

4.2.4. Communication network of authors, hashtags, and addressees

In our overarching fourth research question, we were interested in the differences in the use of co-occurring hashtags and addressees by the main stakeholders authoring the Twitter messages. Combining the previous steps, thus relating authors to hashtags and addressees provides a holistic communication network of the entire issue arena. The network visualization shows us both the shared and the unique hashtags and addressed actors, used in the tweets by the different authors (Fig. 8).

The most striking finding is that the conventional industry and environmental organizations, as authoring stakeholders, formed a shared cluster, mainly due to both stakeholders using the main issue-specific hashtags referring to the most frequently addressed actor (@pluimveetweet). Both stakeholder groups also referred to more specific hashtags and addressees. Specifically, environmental organizations were more closely connected to the other two main clusters formed by media and citizens in their pattern of hashtags

Fig. 8. The entire communication network of co-occurring 44 hashtags and 38 addressed usernames (≤ 2) in the tweets by the 8 stakeholder groups.

and username usage.

Media actors often referred to news-related hashtags such as #nieuws (news), and #news, often in combination with the issue-related hashtag #griep (#flu) which is solely used by media stakeholders. The media formed a unique pattern of hashtag and username usage, with only few, generic hashtags shared with other authoring stakeholder groups.

Twitter messages authored by citizens displayed a higher diversity. Citizens addressed media actors, the central government (#Rijksoverheidnl) and regulations (#ophokplicht), but also protests against those regulations (#kippendans, chicken dance). In addition, we see that citizens connected this debate to other issues, such as #vuurwerk (firework) and #jacht (hunting) that had previously been subjected to societal debates.

In summary, the bird flu as an issue was created by information dissemination about outbreaks of the epidemics and regulations to contain their spread. Taking into account the stakeholders as (active) authors and as (passive) addressees, in relation to the hashtags showed citizens and media as the most active stakeholder groups authoring Twitter messages. These two stakeholder groups formed their own clusters with specific patterns of addressing other actors and using hashtags. The media tended to refer to other media on Twitter, and tagged messages with geographical locations. The citizens, in turn, contributed with a high diversity of hashtags to the debate.

5. Discussion and conclusion

We aimed at providing an automated communication networks approach for research on the concept of issue arenas, recently proposed by Luoma-aho and Vos (2009, 2010). The automated approach offers new opportunities for exploring and mapping, specifically, passive participants and sub-topics in issue arenas, which is relevant for both the academic debate and the practice of public relations. We discuss our insights from four angles: empirical insights on this case; theoretical aspects related to network theory and issue arenas; methodological implications; and implications for public relations practice.

Empirically, it is striking that media actors are by far the most active authors in the debate (as indicated by their amount of tweets), but that they operate in relative isolation, as was shown in the network analyses. The media and the citizens as the main active stakeholder groups rarely use the same hashtags and addressees. Media actors thus seem to use Twitter as a medium for information dissemination, using little shared hashtags and merely addressing users in their own cluster, whereas citizens address users and hashtags across different clusters. The same goes for public organizations: they are positioned in the peripheries of the social and socio-semantic networks. This could be problematic from the perspective of regulation and public information: if public organizations and regulatory agencies are not engaged in the debate, there is no authoritative source of information, which could enhance the spread of fake news. Moreover, these findings confirm research on organizational use of social media that has repeatedly revealed a lack of dialogic activities and preference for information dissemination by organizations (e.g., Lovejoy & Saxton, 2012).

Theoretically, the network analyses reveal that Twitter indeed facilitates societal debates, as two stakeholder groups with different interests (conventional industry and environmental organizations) share the same patterns of using the generic hashtags and addressees. This finding indicates that hashtag use, but also addressing other actors, on Twitter can have performative consequences: hashtags enable actors to coproduce or contest existing opinions, situations or power relations (Albu & Etter, 2016). The use of hashtags and addressing actors can be considered as low-threshold resources that stakeholders can use in their strategies to foster their goals regarding the mobilization of other actors or the initiation of social change (Stevenson & Greenberg, 2000).

To network theory but also the issue arenas perspective, our approach adds an analytical distinction between stakeholders as active authors and as passively addressed actors. While this distinction has been made conceptually for issue arenas (Luoma-aho & Vos, 2010) or latent, inactive publics have been contrasted more generally to active publics (Dozier & Grunig et al., 1992; Hallahan, 2000), empirical approaches to detect passive publics are rare. Focusing on addressees as passive stakeholders in the debate, we find that authors differ in their targeting of stakeholders. This implies that the diversity of the active publics is positively related to the diversity of passive publics. In addition, considering how passive addressees and hashtags co-occur in the tweets, extends upon the discussions of the central organizing role of connectors (Castells, 2015) or social media mediators (Himelboim et al., 2014). Following actor-network theory (Latour, 1996; as also in Luoma-aho & Vos, 2010), we argue that in addition to stakeholders as authors, also addressees and hashtags can have agency in social media debates.

The new methodological approach to issue arenas allowed us to combine different types of network analyses on online debates. Three characteristics of this approach are most important when it comes to the analysis of issue arenas. The main advantage of this network approach is that it is automated, and has also successfully been applied to the mapping of a bigger data set of over 70.000 tweets on the Rio + 20 meeting (Hellsten & Leydesdorff, 2017). Automated mapping of issue arenas certainly does not substitute but rather complements the more qualitative approaches that have been applied so far. Second, the automated tool is flexible: one can select to focus on only the co-occurring hashtags, or only the addressed usernames instead of the username-hashtag networks, depending on the research question. This flexibility of the tool opens up new avenues for public relations research and practice. For example, one can select a specific organization as the focal point, and map the addressee-hashtag networks related to that particular organization, or automatically monitor the issue arenas in which one's organization, or competing organizations are addressed on Twitter. Third, the bottom-up detection of addressed stakeholders and sub-issues prevents personal, academic, or organizational biases that might occur with an a priori selection of stakeholders and subtopics. In that way, the method can also be applied for identifying different types of issue arenas. Whereas our focus here was on an unintended issue, hashtag-username networks of other types of issues might be more fragmented into separate clusters. Himelboim et al. (2017) identified four types of social network structures: in-group, polarized, brand, and community clusters. Future research could assess to what extent the addressees-hashtag networks differ according to these structures and, consequently, constitute different types of issue arenas.

The method opens up a new perspective on public relations research and practice as it shows that issue arenas highlight different aspects of stakeholder relations and debates in which organization are involved on different levels. From a strategic perspective, both an active author role (e.g., starting a hashtag, active engagement in the debate) as well as passive, addressee roles are relevant aspects of monitoring for organizations, depending on their position toward the issue at stake. In the bird flu debate, the conventional industry actors were directly affected, whereas public organizations had regulatory responsibilities. The level of participation in the debate could thus also be related to the type of involvement or formal responsibilities. If an organization's reputation is at stake, for example, active engagement would be an appropriate manner to respond (Coombs, 2007). In our case, however, conventional industry was less active in authoring messages and was also rarely addressed by other stakeholders. Outside crisis situations, organizations might want to engage with issues that are of strategic importance for building reputation and maintaining legitimacy (Pollach, 2015). To this end, organizations can monitor issue arenas to discover how their stakeholders author messages, and address other actors and organizations.

Our bottom-up approach allows organizations to detect these passive stakeholders (addressees) and topics, in addition to traditional stakeholder analyses. Specifically, this perspective includes participants in the issue arena who operate at greater distance from the organization, compared to 'traditional' stakeholders, and who are defined by their involvement with the issue rather than their involvement with the organization. Discerning active and passive roles may enhance a broader perspective on societal sensitivity by public relations professionals as well as their reflection on the role and position of their own organization in relation to that issue (Van Ruler & Verčič, 2005). The mixed method approach proposed here can assist corporations in issue monitoring and stakeholder detection. But more importantly, as an extension of issue-centered stakeholder management (Roloff, 2007), the proposed socio-semantic networks allow a more detailed assessment of the position of an organization within one or several sub-arenas of an issue arena. Such insights may be used for the strategic planning of an organizations' involvement with an issue. Consequently, it is crucial to filter the information that results from monitoring processes to recognize issues and actors that can affect the organization. In addition, the organization has to determine whether or not to participate in issue arenas based on knowledge on the strategies and consequences of the use of public relations in an online environment (Kelleher, 2015).

5.1. Limitations

Concerning the methodological approach, several limitations should be discussed. First, as any study based on social media data, the findings are constrained by the selection criteria applied. Specifically, omitting relevant search terms but also the inclusion of less relevant terms can lead to a biased representation of a debate. Second, not all tweets contain #hashtags or @usernames. However, most of the tweets do contain these Twitter specific affordances. In future studies, the results of this automated analysis of co-occurring hashtags and usernames could be compared with automated semantic network analysis using words used in the content of the tweets. A third, related limitation is that not all stakeholder groups use #hashtags and @usernames in the same way. In particular, private citizens use a wider diversity of #hashtags and @usernames in their tweets than journalists. From the perspective of communication networks, there is need for further research into the differences in the level of active usage of Twitter specific affordances, and how this may affect the communication networks. The approach proposed here can help to better understand the differences in hashtag and username usage by various stakeholder groups. For example, to what extent do individual citizens generally diversify or expand discussions through a more varied, or creative, use of unique hashtags? Do media form separate clusters of addressing mainly other news media organizations and using news related hashtags also in other types of arenas? While our approach allows to quantitatively assess passive stakeholders, the possibilities of Twitter data to obtain a more nuanced view, for example, discerning latent and aware public (Dozier & Grunig et al., 1992) are limited. However, Twitter-specific affordances of targeting other users might ease the transfer from 'low' to 'high' involvement (Hallahan, 2000), thus transforming latent publics into aware and possibly active ones. This potential could be subject to further research.

The current study focused on one public debate concerning bird flu in the Netherlands, and on one type of social media, Twitter. Future research could compare different types of debates, for example, comparing epidemics triggered issue arenas with political issue arenas but also follow issue arenas across different social-media platforms, such as Facebook and YouTube. The method can be further adapted to account for affordances of these social media, such as likes, shares, replies, and comments. To further develop the analytical approach, a comparison to semantic co-words as an indicator of implicit frames (Hellsten et al., 2010) can be added offering a more detailed understanding of the semantic nuances, and agency in online settings. Naturally, insights concerning the selected case are influenced by the cultural as well as socio-political context. The high relevance of Twitter as social medium in the Netherlands and a high sensitivity for agricultural issues, for example, might have contributed to more stakeholder engagement compared to other countries. Mapping the interrelations between active and passive stakeholders and subtopics can complement more qualitative accounts of issue arenas that focus on discursive structures and developments or prevailing narratives in public debates. From a practical point of view, this approach can assist in issue monitoring and stakeholder detection.

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