



An Exploratory Case Study on Data Breach Journalism

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ABSTRACT

This paper explores the novel topic of data breach journalism and data breach news through the case of *databreaches.net*, a news outlet dedicated to data breaches and related cyber crime. Motivated by the issues in traditional crime news and crime journalism, the case is explored by the means of text mining. According to the results, the outlet has kept a steady publishing pace, mainly focusing on plain and short reporting but with generally high-quality source material for the news articles. Despite these characteristics, the news articles exhibit fairly strong sentiments, which is partially expected due to the presence of emotionally laden crime and the long history of sensationalism in crime news. The news site has also covered the full scope of data breaches, although many of these are fairly traditional, exposing personal identifiers and financial details of the victims. Also hospitals and the healthcare sector stand out. With these results, the paper advances the study of data breaches by considering these from the perspective of media and journalism.

CCS CONCEPTS

• Security and privacy → Human and societal aspects of security and privacy.

KEYWORDS

Cyber crime; crime news; crime journalism; sentiment analysis

ACM Reference Format:

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1 INTRODUCTION

Data breaches are a constant and enduring foul hindrance to consumers, citizens, companies, public sector organizations, and others in the modern digitalized societies. With these cyber attacks, cyber criminals steal sensitive personal data of consumers and citizens, valuable business data of companies, and data from various other organizations. Despite continuous investments to cyber security, data breaches have in fact again increased in recent years [22]. Although data breaches are a technical research topic, these have

frequently been investigated also from other perspectives. Organizational aspects have been a common research topic together with human security perspectives. Societal perspectives have been rarer.

Data breaches are often, but not always, about cyber crime, and crime is very much also a societal topic. Crime and media, in turn, are closely associated, and media too is very much a societal topic. These assertions provide a rationale for the present paper to examine the previously more or less unexplored topic of data breach journalism. The motivation is built around the long and debatable history of traditional (non-cyber) crime news and crime journalism. The frequent sensationalism and negativity in this type of news and journalism provide a motivation to not only examine the data breaches reported but also the style of this reporting. In addition, the discussion in the opening Section 2 addresses the potential consequences from data breach journalism, including for the victims of data breaches, media and journalists, and a society at large. Subsequently, Section 3 outlines the materials and methods for the case study. The exploratory text mining results are presented in Section 4. The final Section 5 summarizes the key results, enumerates a few limitations, and outlines paths for further research.

2 BACKGROUND AND FRAMING

2.1 Crime News and Crime Journalism

Data breaches can occur in multiple ways. These include also factors related to human behavior and organizational postures [41]. Both malicious motives and innocent mistakes may be involved. An accountant may accidentally disclose sensitive financial data, a salesperson may unnecessarily carry sensitive customer data that leaks, management may be unaware of the security risks in the face of mergers and acquisitions, a disgruntled and indebted employee may sell sensitive data to an adversary, and so forth and so on.

More often, however, data breaches nowadays occur online through exploitation of technical vulnerabilities in software systems. Such exploitation shifts the focus more explicitly to cyber crime. This characterization is true also in media within which big global data breaches frequently attain flashy headlines. Furthermore, data breaches form their own specific cyber security news niche already because these are almost always tied to specific events, unlike many other cyber threat narratives in media, such as those related to national security and espionage [3]. In other words, a data breach in itself is almost always the specific event to which the given data breach news build upon. A data breach event typically also remains as the focal point in follow-up news.

Crime news and crime journalism have a long history, as does the fields that study this form of journalism. Already in the early 20th century (if not earlier), it was common to speculate about and argue over the role crime plays and should play in media and journalism, how crime should be reported, what function crime



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news fulfills or should fulfill in a society, and what consequences it may entail, among other related topics of interest. While crime journalism was an integral historical part in the popularization of media, it was also commonly seen as a hindrance to raising the status of journalism and the professionalization of journalists along the way [36]. To this end, it was commonly argued that crime news should move away from sensationalism, which may increase the risk of emulations and copycats, among other things, toward constructive reporting that informs the people about the dangers in their neighborhoods, possibly leading to beneficial regulatory or other changes for both the public and law enforcement [33]. This characterization captures many typical tenets of crime journalism even today: crime is newsworthy because it is, by construction, sensational, extraordinary, and disruptive; crime tells also about the political realities people live under; and crime news often require resonance with the everyday life of people, and a journalistic way to achieve such resonance is to rely on geographical or historical proximity [14]. It is not difficult to relate these tenets to cyber crime and data breaches in particular. Data breaches are often sensational because they showcase the banality of the cyber (in)security of many organizations; data breaches can act—and have acted—as a major political force pushing new cyber security regulations onward; and historical proximity is guaranteed because everyone in practice knows a previous breach—if not a victim of such a breach.

Recently, the debate has also touched victims of crime and victimization, meaning the process of becoming a victim or being victimized by someone. Here, to begin with, exposure to sensational (or negative) crime news tends to increase the perception of people about the probability of becoming a victim of a crime [50]. This effect is presumably partially due to the pervasive notion of risk in crime news, which often report on serious and seemingly random crimes committed by strangers [27]. Again, it is not difficult to draw an analogy to data breaches; if it can happen to everyone, it can happen to me as well. Though, it must be added that considerable skepticism has been expressed over whether people consume crime news because they want to learn about crime statistics and related robust details about crime or because they want to entertain themselves, protect collective moral identity, moralize on political conflicts, or something along these lines [18]. Such consumer appetite is a central factor behind a common criticism that crime news tend to create an oversimplified or outright false picture of crime, rather promoting existing fears, stereotypes, biases, and prejudices [27, 43]. That said, there is also criticism of the criticism, particularly with respect to the assumption about the effect of crime news upon audiences [10]. In any case, the use of victims (instead of criminals or suspects) in crime news may perhaps help to mitigate unintended consequences. Regarding data breaches, it is indeed not difficult to find examples of human interest stories whereby a breach is approached through its consequences to the victims.

Also other affected people may appear in crime news, including, of course, law enforcement or other public authorities, but also eyewitnesses and people related to a suspect or a victim often appear in crime news. For instance, eyewitnesses can be used in crime news to give a mediated witness experience whereby the consumers of the news align their emotional response to those affected by a crime [49]. Although such journalistic techniques may in theory appear also in cyber crime and data breach news, it is more

common to see a voice from law enforcement in these news. In fact, for reasons soon to be discussed, data breach news often rely on official statements from law enforcement as the building blocks for the news. This sourcing may lead to a known bias, given that a law enforcement perspective is not alone the only relevant viewpoint to crime [40]. Therefore, it is worth further remarking that not only interviews of law enforcement officials but also interviews of data protection authorities and cyber security experts sometimes appear in cyber crime and data breach news.

Finally, it should be emphasized that crime journalism is culturally dependent with different geographic regions having different traditions and frameworks for crime news reporting. What works in the United States or Southeast Asia may not work (or even be legal) in Germany. Also the levels of professionalization likely differ. For instance, in some Nordic countries crime journalism enjoys the same level of professionalization as other types of journalism, being also subject to the same ethical and related guidelines monitored by self-regulatory councils, although, paradoxically, it was also the criticism on the sensational crime news that partially led to the professionalization and associated media practices [36]. That said, crime news have increased in volume also in some Nordic countries, and much of this increase is attributable to tabloids who may be less strict about ethics and professional practices [43]. This point serves to underline that the long-lasting debate on crime news and crime journalism is still alive today in most countries.

2.2 Potential Consequences

In light of the previous discussion, it is helpful to consider the case in a larger context of data breach journalism and its potential individual, economic, societal, and other consequences. Thus, the following seven points briefly consider the potential consequences from data breach journalism in a larger context.

First, it may be that data breach journalism shares the same sins as crime news generally. In particular, it may be biased in various ways. For instance, it may exaggerate the security risks from data breaches, potentially leading to uncalled fears among the public. Consequently, data breach journalism may contribute to painting of the Internet as an excessively insecure and dangerous place. These points align with an argument that cyber crime tends to be often associated with a moral panic in media, which may also have unintended consequences, such as inefficient resource allocation or poorly justified legal powers granted to law enforcement agencies [19]. However, it is impossible to evaluate how realistic these points are in practice; the evidence is in the eye of the beholder.

Second, there is a potential risk of data breach journalism cultivating new cyber crime through inspiring aspiring cyber criminals, hooligans, and other perpetrators. Fame is supposedly of high value in cyber crime circles, and big data breaches are a sure way to attain fame. However—and unlike with some other types of crime, information technology media generally lacks a true crime genre, which at least implicitly may glorify crime and criminals, potentially leading to the copycat behavior, as has been the case with respect to violent drug crime in some countries [34]. While there are some media that come close, such as *Darknet Diaries*, these are rare and supposedly not that popular among a wider audience. To perhaps exclude high-profile crime syndicates, in cyber crime

the dynamics of fame supposedly largely happen among cyber criminals themselves in darknet and closed underground forums.

Third, data breach journalism may cause additional harm to the victims. Here, it is important to stress that many—if not most—data breaches involve two types of victims: the companies or other organizations who were breached and the persons, customers, business associates, or other types of stakeholders whose data was breached. The potential harms differ between the two types. Although the evidence is not entirely conclusive, data breaches may even affect the stock prices of the victim companies who were breached [44]. Analogously, losing sensitive data of business associates to criminals is hardly good business. Regulations such as the General Data Protection Regulation (GDPR) have also introduced potentially large financial sanctions from data breaches. Therefore, it is no wonder that data breaches are a significant reputation threat to companies [45]. To protect their images, companies and other organizations typically use different crisis communication strategies when dealing with data breaches, and these may also affect the narratives presented in media [39]. However, it is difficult or even impossible to say whether a company is still better off with a data breach compared to a ransomware attack whereby the company's data is encrypted and kept as a ransom. Nevertheless, in both cases the potential consequences provide a clear incentive for companies to keep the information disclosed to media as limited as possible. In terms of the other victim type, a good albeit morbid case would be the Finnish *Vastaamo* breach. It involved a breach of a psychotherapy center whose patient records were leaked to the darknet and further used as extortion material. Given the sensitivity of the data involved and the psychological state of the victims, the constant news coverage of the breach may have caused additional stress to the victims—or patients. This case aligns with arguments on the elevated victimization of data breach victims after a notification of a breach [13]. The example also demonstrates that data breach journalism involves its own ethical considerations.

Fourth, data breach journalism may also help the user-style victims by raising awareness among them. Indeed, information about data breaches has been observed to correlate with security awareness [8, 23]. A correlation has been further found to awareness of data protection regulations, including the GDPR [51]. Then: if social security numbers and bank account details have been breached, a risk of identity thefts may be significant enough to warrant reporting also in media. By becoming aware of a breach, the persons affected may then take necessary precautions. Unfortunately, however, this line of reasoning does not necessarily hold that well because existing results also hint about poor practical security posture among users even after they have become aware of an incident through media or by other means [2, 23]. Another way to look at the awareness question is to focus on the other victims; data breach journalism may help users also by shedding light on companies or organizations with haphazard security practices. The major *Equifax* breach in the United States serves as an example along these lines, which again resemble the constructive crime journalism ideals.

Fifth, a potential downside of awareness raising is so-called data breach fatigue. Indeed, some studies indicate that at least a portion of audiences has become tired of constant bombardment of data breach news [31]. To counter this fatigue problem, media outlets

might concentrate on bigger data breaches with feature journalism instead of plain reporting on daily breaches.

Sixth, data breach investigations require trustworthy frameworks and secure communication channels between the parties involved, including, but not necessarily limited to, the victim organization, the investigators, and possibly law enforcement or other governmental agencies [47]. If sensitive details leak to media during an investigation, wild headlines may follow but these may hamper the given investigation. Such scenarios again underline that data breach journalism should follow its own ethical practices. Ethics apply also to the relatively frequent cases in which a data breach is found by a non-malicious third-party who may report it both to the given organization and media [17, 39]. In terms of ethics, the issue is rather similar to voluntary reporting of vulnerabilities to vendors. Moreover, regulations such as the GDPR have introduced notifications to the natural persons affected; therefore, leaks to media are likely to occur in any case. That said, leaks should not downplay ethics in journalism and associated professional practices.

Last but not least, it is possible to remain true to crime journalism and maintain that “news does more good than harm” [33]. If nothing else, data breach journalism, especially in the context of the case studied, helps to keep public records straight. While vigilantism is a potential threat, this line of argumentation aligns with observations that the public, after having become aware a cyber crime, may help at resolving the crime, especially when done in cooperation with law enforcement agencies [15]. Finally, as there is no robust global database on data breaches, a systematic journalistic reporting on breaches can also create rich archival data for data mining.

2.3 Related Work

According to a fairly comprehensive literature search, no directly comparable previous works exist. Having said that, there are some studies that come close to the present paper's theme and its framing. Mimicking existing work for quantifying general crime news [21], attempts have been made to profile different cyber crimes through online news coverage [7]. According to this data mining branch of research, moreover, data breaches are often reported negatively in media, including with respect to the victim organizations [24, 42]. Such results are hardly surprising in the sense that negative news commonly surpass positive ones, partially because negativity often drives consumption [35, 48]. Perhaps due to this demand-side, even many journalism textbooks tend to rationalize the commonplace reporting of crime, conflict, and bad news [29]. These results reinforce the earlier point about the reputation threat from data breaches.

Besides the odd paper or two, there appears to be no explicitly related previous works. Implicitly, however, the paper has connections to many directions, as indicated by the points raised and the works referenced in the previous section. Of these directions, the so-called event studies are noteworthy because these have used data breach news as an explanatory factor in explaining firms' economic performance [44]. If the scope would be enlarged to crime news and crime journalism more generally, also the amount of related works would enlarge. Regarding cyber crime and particularly data breaches, however, the amount of related works is minimal.

3 DATA AND METHODS

3.1 Data

The dataset was assembled by web scraping *databreaches.net*'s content. The category of breach incidents was used for downloading the news articles. There were 19,348 news articles in this category during the data retrieval in April 21, 2024. However, not all of these articles are about data breaches; there are plenty of non-breach cyber crime and general cyber security news in the category as well. Therefore, as a case-specific solution, only those news articles were further processed whose lower-cased titles contained the character string *breach*, *leak*, *steal*, or *stole*. The latter two strings are used to cover the various cases whereby either employees have stolen data or computers and the data stored in them were stolen.

Due to the various ways data breaches can occur, the four strings do not capture all cases, of course. For instance, *databreaches.net* has reported also on the several cases of data being found on dumpsters or other places, the cases where employees have accidentally sent personal data by email or posted the data on social media, and so on. However, according to some studies, only a minority of breaches is due to inside jobs; the majority is due to external, remote technical exploitation, and lost or stolen equipment together attain the second place [30]. Although also unauthorized disclosures have been common in some sectors [20], the two typical cases are well-covered; technical exploitation and more traditional theft. A portion of unauthorized disclosures is additionally captured by the character string *leak*. The resulting sample size of $n = 5,861$ news articles is also more than sufficient for the paper's exploratory purposes.

3.2 Methods

The overall methodology taken is an exploratory case study [12]. In other words, the goal is to explore the dataset without strict prior hypothesis, providing a rich detailed study on the particular case, generating hypothetical paths for further work, and in this way advancing the previously unexplored field of study. As the name indicates, *databreaches.net* concentrates on data breaches, and, hence, it provides also an ideal case to study data breach journalism. That said, the methodology has its own limitations, which are discussed later on in Section 5.2. For the present purposes, it is more important to focus on a few practical computational details.

Most of the quantified information is extracted by conventional parsing of the meta-data or the content of the news articles. Instead of elaborating this everyday computing, a few words must be written about the ways the content of the articles is summarized. Instead of relying on topic modeling, the most frequent "topics" are briefly probed and summarized with bigrams (that is, two consecutive character strings). To construct the bigrams, the following steps were used after having lower-cased and tokenized the body of the news articles according to white space and punctuation characters: only tokens representing alphabetical character strings recognized as English words were included, tokens with length less than three or larger than twenty characters were excluded, and tokens matching stopwords were also excluded. After this pre-processing, the tokens were lemmatized into their basic English dictionary forms.

Two libraries were used for this processing [26, 46].¹ In addition to this simple bigram processing, sentiment analysis is used to probe for the potential sensationalism in the news articles.

The lexicon and rule based VADER algorithm is used for computing the sentiments [16]. There are a few things bespeaking for the algorithm in the present context. Namely, it is simple, easily available, and hugely popular. Despite the algorithm's simplicity, it also performs well in benchmarks [32]. Regarding popularity, on the other hand, there are literally thousands of studies (if not more) that have used the algorithm in various contexts. For the present purposes, it suffices to note that the algorithm has been used to examine the sentiments in news articles [5]. Whatever the application context, the algorithm assigns positive and negative values to words, and then combines the values that appear both in the VADER's lexicon and the given input text. The final score is normalized into a range $[-1, 1]$. In light with the discussion in Section 2.3, negative values, meaning negative sentiments, could be expected for much of the news articles. After all, crime is a negative phenomenon and sensationalist crime news have a long history.

4 RESULTS

4.1 Sample Characteristics

Four points about the sample are a good way to start the empirical exploration. Thus, first, Fig. 1 shows the number of news articles published across the time period observed. As can be seen, the outlet has kept a steady publishing cycle; on average, about two news articles were published each day. That said, there have been some notable gaps in the publishing over the years. As a small outlet, a lack of sufficient human resources may explain these gaps.

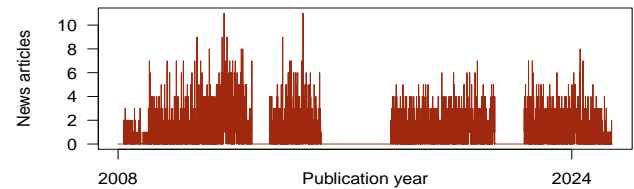


Figure 1: Publication Dates

Regarding time series trends in general, it has been hypothesized and observed that recent events and transformations, such as COVID-19 and increased remote work, may have increased the amount of data breaches [28]. However, such conclusions are uncalled for with the present case study; data breaches are one thing and journalistic reporting on them another. There is also another point worth making about the longitudinal aspects: data breaches take a long time to be detected. According to some studies and industry reports, even more than a hundred days is typically required before a data breach is detected within an organization [17, 37]. If no leaks occur to journalists, supposedly a long time is further required before news about a breach appear in media. Thus, the

¹ In addition to the stock stopwords in the library used [46], the following stopwords were used: *data*, *breach*, *story*, *new*, *newly*, *update*, *case*, *posted*, *reported*, *information*, *web*, *site*, *may*, and *must*.

publication dates shown do not likely say much about the actual dates of the data breaches discussed in the news articles.

Second, as can be concluded from Fig. 2, the news articles are typically very short. In fact, the mean length, as measured by the number of tokens (that is, words), is about the same as the length of a typical abstract in a scientific paper. Although also longer news articles are present, it can be concluded that the typical articles do not perhaps have much journalistic ambition. Instead, these focus on plain reporting on data breaches, short and simple.

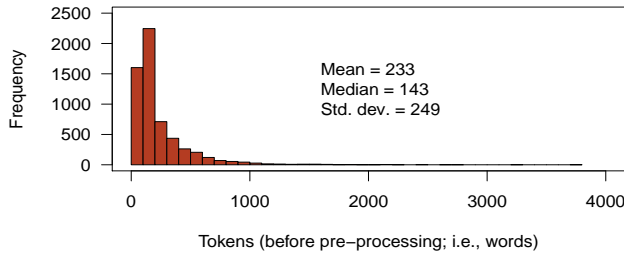


Figure 2: Length of the News Articles

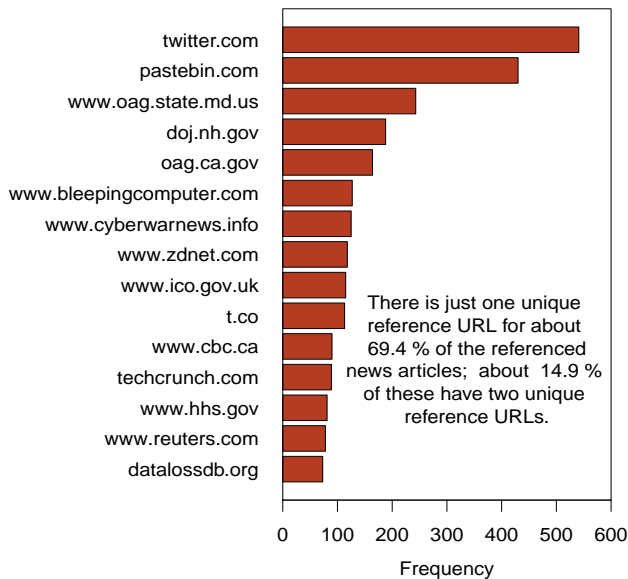


Figure 3: Top-15 Domains in the Articles' URL References

Third, the site offers commenting functionality but it is not much used. In fact, only about 5% of the news articles in the sample have seen at least one comment. While this observation cannot be equated to popularity, it can be still concluded that the site itself does not rely on social aspects for its reporting.

Fourth, a few interesting observations can be made based on the sources on which the news articles are based. A simple way to approximate the sources is to focus on the domain names that appear in the uniform resource locators (URLs) embedded to hyperlinks in the body of the news articles, excluding self-references to other

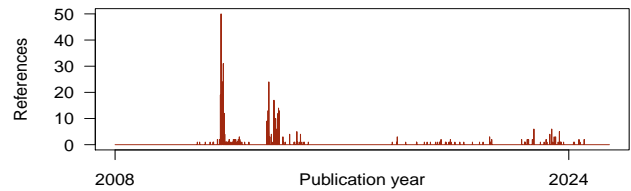


Figure 4: Publication Dates of Twitter References

news articles on *databreaches.net*. The top-15 most referenced domains are shown in Fig. 3. The most notable observation is present in the text embedded to the middle of the figure; most cases are referenced with a single unique URL. This observation hints that most of the cases are referenced with primary sources that likely point toward the victim organizations. Although such referencing clearly increases quality, there are also quite a few references to X/Twitter. It may not be a big sin, however, given that also mainstream media nowadays tend to often reference this social media platform. It may also be that X/Twitter has gained prominence in data breach reporting. However, according to Fig. 4, most of the references were made in the late 2000s during which also X/Twitter's popularity peaked. Otherwise, a commonplace English language bias seems to be present, which is expected. Technology news sites in English, the public broadcaster from Canada, the data protection authority in the United Kingdom, and several governmental websites in the United States have been relatively frequently referenced in the news articles. All are quality sources. Finally, it should be also remarked that the site occasionally uses also traditional journalistic referencing, mentioning a source for a news article in plain text, without providing associated hyperlinks to the online origins.

4.2 Topics

The bigrams provide sufficient material to deduce about the typical cases discussed in the data breach news articles. To this end, Fig. 5 displays the top-25 bigrams present in the pre-processed sample. In addition, Table 1 shows the sectors of the victim organizations according to existing meta-data provided by the news site. None of the sectors exhibit notable longitudinal trends; the data breaches have affected the five sectors rather uniformly across time.

Table 1: Sectors According to Meta-Data

Sector	% of breaches
Healthcare	33.3
Business	26.7
Government	16.6
Education	10.9
Financial	5.4
Other	7.1

The following points can be used to summarize the results:

- Many of the breaches have involved data that can be used to either directly or non-directly identify natural persons.

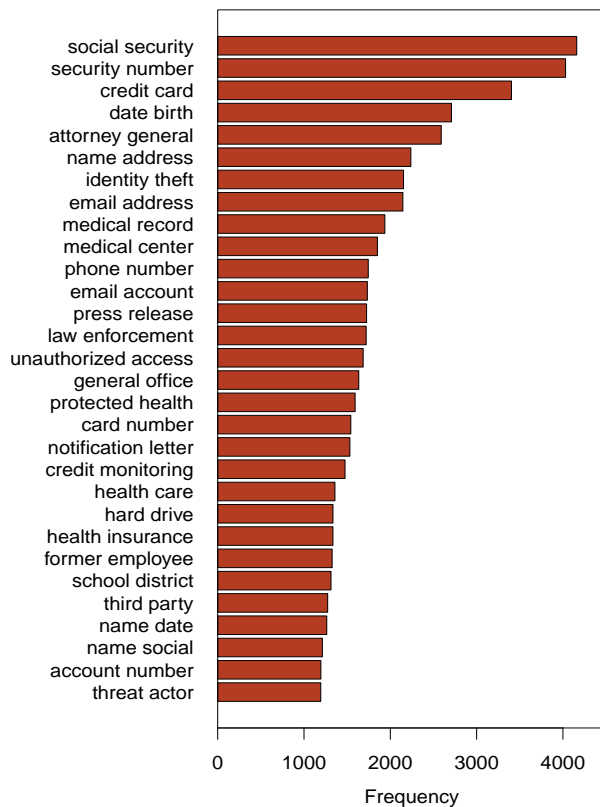


Figure 5: Top-30 Bigrams

The examples include social security numbers, dates of birth, email and street addresses, and phone numbers.

- Commercial data is well-represented; according to the meta-data, the financial and general business sectors together account for about 32% of the breaches reported. According to the bigrams, the breaches have often involved credit card details. Also credit monitoring organizations are covered. Furthermore, supply chain attacks or crimes are present, given that 8% of the cases have involved subcontractors according to the existing meta-data provided by the site.
- Due to the nature of the data breached, and despite the sampling strategy (see Section 3.1), the news articles have also addressed related crime, as manifested by the bigrams `identity theft`, `attorney general`, and `law enforcement`. In addition, the bigrams `former employee` and `hard drive` hint that not all of the data breaches have occurred because of technical exploitation, as was expected. Indeed, according to the meta-data, about 9% of the data breaches have been inside jobs and about 8% have involved stolen equipment.
- The healthcare sector is represented particularly well. There are also many bigrams explicitly related to the sector, including, but not limited to, `medical record`, `medical center`, `protected health`, and `health insurance`.

- In addition to healthcare, which may have public sector ties, the public sector is also otherwise well-represented, as hinted by the bigram `school district`. In fact, together the education and government sectors account for about 28% of the data breaches according to the available meta-data.
- Although information security incidents have been a common cause for GDPR fines [38], only seventeen news articles have contained the character string `gdpr`. This observation likely reflects the English language bias and the origins of the news site in the United States. Indeed, the character string `hipaa`, as for the Health Insurance Portability and Accountability Act (HIPAA) in the United States, already accounts for 221 mentions in the data breach news articles. Also the California Consumer Privacy Act (CCPA), which was motivated by the GDPR, has gathered one reference.

All in all, the most frequent bigrams indicate that many of the cases are bread and butter data breaches. However, this mundane nature of many of the breaches should not be taken to undermine the risks to the victims. As many—if not the most—breaches have involved direct personal identifiers, identity theft is a real risk for the victims. This risk is further increased by the widespread leakage of credit card and credit ranking details. Alongside with the discussion in Section 2.2, it can be also remarked that according to some studies, some consumers rely on fraud prevention services after having become aware of a breach but these people still use existing credit cards, and data breach news have generally only a limited impact upon consumer behavior [25]. Thus, the risks are real in the sense that these may involve financial losses, lowering of credit ratings, or something similar. Regarding financial or other crime, it can be also remarked that about 16% of the news articles have contained a character string from the list `detain`, `criminal`, `suspect`, `jail`, `prison`, and `fine`. Although this detail again pinpoints that the sampling strategy is not perfect, it also serves to underline that many of the cases are about serious crimes and security lapses. The appearance of these strings may be amplified by the frequent sourcing of the material from law enforcement, public attorneys, data protection authorities, and related official figures.

The healthcare data breaches warrant a brief discussion too. Although financial crime may be involved due to stolen health insurance details, the risks associated are likely different for many victims. As was already noted, leakage of patient records may cause psychological stress to many victims. These can be used also on more serious crimes, such as blackmailing schemes. In terms of the victim organizations, on the other hand, healthcare data breaches are particularly costly for the organizations involved [17]. Another big question is why hospitals and healthcare organizations in general are so prone to data breaches and cyber attacks in general. Alas, the reasons are many. Security awareness, human competencies, organizational postures, and financial resources are problems, but these are further exacerbated by lack of oversight bodies and poor governance of healthcare systems [11, 20], among other things. For the time being, it seems sensible to expect widespread insecurity of hospitals and healthcare facilities also in the foreseeable future. The data breaches presumably do not stop in this sector, no matter how difficult the consequences are for the victims of the breaches.

4.3 Sentiments

Sentiment analysis is the final step in the empirical exploration. Thus, Fig. 6 displays the sentiment polarity scores for the news articles and their titles. Unlike what was expected and contrary to existing research results [42], the news articles split almost perfectly into half between negative and positive polarity scores. Moreover, there are not many articles with values around zero, indicating that the news articles tend to exhibit relatively strong negative or positive sentiments. This observation is even more surprising when consider the short length of the articles. Emotionally loaded language provides one explanation, although it is difficult to speculate why positive sentiments have been common in the articles. In contrast, the articles with negative sentiment polarity scores are presumably at least partially due to the relatively widespread appearance of crime-related topics in the news articles. Moreover, as can be seen from Fig. 7, the sentiment polarity scores have remained stable across time. Thus, the negative or positive sentiments cannot be attributed to a sudden change in the news site’s reporting style.

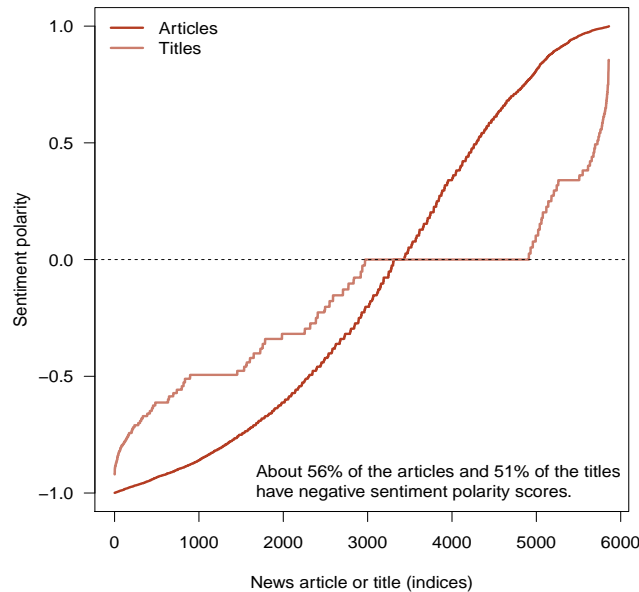


Figure 6: Sentiments

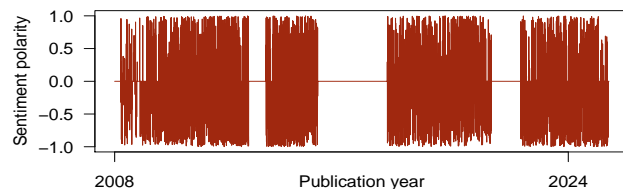


Figure 7: Sentiments Across Publication Dates

The titles of the articles exhibit a relatively large volume at the value zero, meaning no sentiment tendency to either direction. Even

then, however, also the titles tend to split between negative and positive sentiments. These may indicate the presence of so-called clickbaits, although a closer examination can be left to further work.

5 DISCUSSION

5.1 Conclusion

This paper investigated the mostly unexplored topic of data breach journalism with an exploratory case study of *databreaches.net*. The paper’s results can be summarized with the following points:

- The news site has kept a steady publishing pace, although there have also been some gaps in the publishing over the years. On average, two data breach news articles have appeared on each day after the site’s launch in 2008.
- The news articles are very short; the site concentrates on plain reporting instead of feature journalism or other more in-depth investigations.
- The news are often sourced with primary material from the victim organizations. Although also social media is present, additional news material includes high-quality sources, including technology news sites, criminal justice systems, and data protection authorities. That said, practically all of the sources are in English, which likely reflects a geographic bias.
- The full scale of data breaches has been covered. However, many of the breaches discussed by the news site are fairly traditional, exposing direct personal identifiers and financial details of the victims. In addition, hospitals and the health-care sector stand out as frequent victims of data breaches. The breaches are often discussed in relation to cyber crime.
- The news articles exhibit fairly strong positive and negative sentiments. The negative ones are expected and understandable due to the presence of crime and the long history of sensationalism in crime news, but the positive sentiments are unexpected and would require further evaluation. The titles of the news articles are more balanced, although also these show a split into negative and positive sentiments, possibly indicating the presence of so-called clickbaits.

In addition to this short summary of the results, a few limitations should be acknowledged. After outlining these limitations, topics and paths for further research are briefly discussed.

5.2 Limitations

A notable limitation stems from the case study approach: there are no other cases to which the results could be compared [12]. Specifically, many of the results would benefit from a comparison to handling of data breaches in mainstream media. Such a comparison would be particularly interesting with respect to the sentiment analysis and the crime characteristics; by hypothesis, there is a difference, although it is difficult to say to which direction. Coverage of mainstream media would be important also in terms of the discussion in Sections 2.1 and 2.2. In other words, *databreaches.net*’s readership is presumably rather narrow, supposedly mainly composed of information technology professionals, whereas the readership of mainstream media outlets is wide; by implication, many of the issues in crime journalism supposedly only

manifest themselves through mainstream media. The same applies to the consequences hypothesized about data breach journalism. Also a few smaller limitations should be briefly mentioned.

One smaller limitation originates from the sampling strategy (see Section 3.1). Notably, the inclusion of news articles with the string breach in the articles' titles covers also cases that have discussed politics, law, and regulations, which are somewhat oddly often entitled as "breach regulations". However, it is not easy to address this limitation: if the strings regulation and law, in turn, would be used to exclude news articles, many relevant news articles would be missed, as the news site has often discussed breaches in conjunction with regulations. A similar point applies to crime news, which, as was noted, still appear in the sample despite the sampling strategy. Therefore, a bias must be acknowledged: not all of the news articles covered are only about data breaches *per se*.

A small limitation is present also in terms of follow-up news that update a given article. Although it is difficult to say how many such follow-up stories are present in the sample, these duplicates may cause a small bias in the results reported. A somewhat different bias stems from potential incorrect reporting to which a niche news site may be subject to. Unlike major mainstream media outlets, *databreaches.net* appears to avoid publishing corrections to previous articles. Nor does it publish potential retractions in case of severely misleading reporting. However, the resulting biases are likely small and unavoidable in the present case study context; deducing about these would require the examination of other media sources.

Finally, limitations of the sentiment analysis algorithm should be briefly acknowledged. The VADER algorithm was developed with social media analytics in mind. Hence, its lexicon may not be the optimal choice in the present context, which might require a custom dictionary tailored specifically for data breach news. This point generalizes toward other, newer sentiment analysis algorithms. Also the other common limitations apply, including sentiment analysis algorithms' poor handling of adverbs, irony, sarcasm, context, and comparative sentences [4, 9]. Sentiment analysis algorithms are also sensitive to different pre-processing choices. In the present context these choices include the sampling strategy in particular.

5.3 Further Work

A few promising paths for further research can be mentioned. As was already noted in the previous section, the scope of the analysis should be extended toward mainstream media. Such an extension

would allow to better understand the results as there would be a comparative case against which the results could be reflected. In particular, the sentiment analysis results would benefit from a comparison; it may be that mainstream media is more prone to sensationalism due to its coverage of traditional crime news as well. Though, there are likely differences among mainstream media outlets as well; the sentiments may be quite different among something like *The Guardian* and *The Register*. A comparison could be done also between the sensationalism (or lack thereof) of cyber crime news and traditional crime news. Furthermore, it would be interesting to know how much data breaches covered by the dedicated outlet are missed in mainstream media due to length and coverage constraints. As the outlet studied does not use images, mainstream media coverage could be used to examine also the visual cues, which are a distinct trait of crime journalism [14]. In addition, coverage in mainstream media is better suited to examine correlations to people's security awareness, among other things.

Another interesting path for further work would involve separating the distinct victim organizations from the data breach news. Although such separation may require manual inspection of the news articles, the resulting data would offer material for many new research questions. For instance, it would be possible to continue the event study approaches by incorporating the results from sentiment analysis as explanatory factors. In a similar vein, it would be interesting to combine resolved data breach crimes, from the initial reporting of the breaches to the actions taken by a criminal justice system. Such a combination would allow to better understand the criminological aspects of cyber crime related to data breaches.

Sentiment analysis could be also used in a slightly different context by modeling the public's responses to data breaches. According to existing results based on sentiment analysis of social media data, the responses tend to exhibit distinct periods marked by anxiety, anger, sadness, and acceptance [1]. Also fear has been observed to be a typical emotional response [6]. Media is likely facilitating these distinct periods; hence, it would be interesting to see whether the sentiments in news articles and social media data correlate.

Finally, it is possible that sentiment analysis is a poor tool to examine longer, more nuanced, and contextualized texts. To this end, qualitative analysis could be carried out to better understand the style, linguistic conventions, and semantics of data breach news and cyber crime news in general. As these supposedly constitute a distinct news genre of their own, it may be that also the linguistic conventions and stylistic elements are distinct among news genres.

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