Lessons from Brexit: How to protect EU citizens from fake news

November 2019

dGen

Insight Report

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European Union Citizens From Fake News**

dGen is a not-for-profit think tank based in Berlin, Germany. We focus on how blockchain technology can contribute to a decentralized future in Europe and what this might mean for people, society, private entities, and the public sector over the coming decades.

We're working with a team of researchers exploring how decentralisation will shape our future. Our insight reports focus on specific topics and industries to drive ideas for adoption in Europe. To find out more, please visit us at dgen.org.

dGen, 2019

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Table of Contents

Forward

Two of the key characteristics of blockchain technology are trust, and immutability. Although the technology comes with a variety of features - a list that is still being expanded as developers and mathematicians explore the limits of engineering and their imagination - it is these two that are both at the very core of the technology and provide so much potential.

After the initial shock of the 2016 referendum and the consecutive US presidential elections, Europeans woke up to the reality of a post-truth world. Social Media has grown in significance and can now amplify the voice of an individual to a level never seen before in human history. Now, we can argue that the right to practise free speech is at the foundation of our democracies, but how do we react when we see it being used to spread misinformation?

Whether this is an act of foreign interference, or simply a result of the polarisation of our political landscape; the result is a loss of trust in the media, our institutions, and eventually our democratic process.

At the basis of fake news we deal with factual information being completely or partially doctored, or taken out of context in such a way to create a strawman or other logical fallacy.

We understand that software will not save the world, and don't expect blockchain to eradicate fake news entirely. But we recognise that this technology could help solve some of the issues, by utilising two of its core strengths: immutability and trust.

Jake Stott & Nick Dijkstra
Founding Board, dGen

Executive Summary

This report critically analyses the effect of fake news on the 2016 UK Referendum, known as Brexit, to discern lessons and develop solutions to protect EU citizens from fake news. We recommend a system that combines civic education and decentralisation to identify and combat the spread of fake news. Brexit has taught us valuable lessons about the state of our politics and the spread of information, and just how technology can be used today to both misinform and protect the general public. With 87% of Parliament members using Twitter and journalist/news outlets relying more heavily on Twitter and other social media networks to reach their constituents and audiences directly, many feel that we live in what could be called a post factual society. We aim to have conversations around the use of technology as a tool to mitigate the spread of fake news, while also ensuring we keep free press as a cornerstone of modern democracies.

Although we recognise the gap between public perception and empirical reality, conversations around the responsible use of technology where truth and lies can be compared for public benefit should be of the highest priority moving forward. If fake news is able to continue to flourish, this not only affects our political due processes, but also has dire consequences on global health and science, as identified in this report.

Fake News in Europe

"[this] creates new business models for news & media outlets, digital publishers, researchers, independent journalists, social media companies and fact checking organisations"

In the case of the UK Referendum, the main influences of fake news were found to be enhanced by extensive use of bot networks. Political groups that strategically generated the most activity on a balanced range of political issues tended to have the most impact. Bias in media coverage was also evident, represented particularly by the BBC's anti-Brexit stance, which prevented the public from receiving balanced opinions and facts. The negative effects of fake news on European political reporting were concerning, with some nations using the media to disseminate fake news that aimed to destroy national democracies and to weaken links between them. This research also found that the extraordinary effect of false information on health was a consequence of individuals failing to validate the information they read on the internet by cross-referencing claims. By appraising potential blockchain solutions to eliminate fake news, and investigating a civic initiative that seeks to educate the public on how to check facts for their authenticity, a new model for eliminating fake news is suggested that combines these concepts to create new business models for news & media outlets, digital publishers, researchers, independent journalists, social media companies and fact checking organisations.

Blockchain Solutions

The major advantages of blockchain are transparency, cryptographic security, decentralisation, and immutability, which means that the block cannot be altered after it has been validated. This is a very important feature in terms of authentic news items being mimicked and presented as established media. To start, it is recommended that journalist/authors are given the opportunity to establish provenance of their work as well as facilitate secure transmission methods and archiving to establish a chain of trusted interactions. Since documents are decentralised and preserved, it ensures that the authenticity of the originals can be traced, giving consumers a secure history to check their sources against. This system can also be used for the reduction of false statements in research findings associated with scientific papers, particularly those associated with open source journals, as it provides a means of references and citations that cannot be corrupted.

Next we recommend moving away from the advertising based model the internet and media outlets operate under currently to one where author, publisher, and public interact directly and are incentivised for these interactions and contributions of content. Paid advertising has the disadvantage that the advertiser may require certain opinions to be published. In the proposed system, content is decentralised to avoid censorship by running it on top of a peer-to-peer network, one of the underlying principles of blockchain technology. This security built-in helps both publishers and readers maintain authenticity and veracity, which partially mitigates fake news. This idea would then somewhat replicate the way that traditional newspapers are partly funded by readers purchasing the publication, by basing the revenue model on agreements to pay for better articles. Blockchain enabled media outlets would be the vehicle to support these models, and have the capacity to keep a permanent record of all newsworthy events in the distributed ledger, for both the benefit of the journalist and future research studies. Interactive journalism could further be employed giving paying customers smart keys to interact with the journalists and to express their views on articles or suggest new subjects, directly. Reader loyalty could be further enhanced by incentivising readers to contribute news items by offering some form of compensation, for instance a cryptocurrency. Finally, in this approach machine learning could be utilised by analysing previous reports to form part of the authenticity system, giving the ability to analyse natural language and put warnings of fake news on content the process deems to be non factual.

In this research 3 main variations of fake news were identified.

- All content was fake
- The title was fake but the remainder valid
- Title real but content all false

A natural language processor identifies the first two types by judging the alignment between title and content, while the third is more difficult to analyse. This is due largely to personal opinion and emotions that separate hard news from soft news.

To tackle the problem of identifying the level of inaccuracy of an article, Artificial Intelligence (AI) models are used to detect these features and rank the article based on the degree of fact using a probabilistic validity scale; high scores indicate high fact articles, but are then further scrutinised for fact patterns that will indicate actual or false features. Instead of using humans to validate articles, which would be extremely labor intensive, blockchain allows for a performance ledger of the outcomes, and AI continuously updates the data hashed and referenced on the system. This system also invites publishers, users and validators to contribute to diminishing the degree of fake news in the media and incentivise them to do so.

Blockchain In Use

Reputable established news outlets are already experimenting with blockchain to eliminate fake news from their published reports, such as the New York Times and its partner companies, which began to implement the proof of work/concept in July 2019 and are trialling it until December 2019 in an attempt to enhance trust in digital archives. The company has begun to use blockchain to encrypt photographs and videos with details of the date, time, and location of their origin, as well as how they were edited and published. When these videos or photographs are displayed on other digital news sites, group chats, or identified by means of search engines, a set of signals can reveal its presence.

By combining machine learning and blockchain to enable the public to test the veracity of news stories.

This system can be used in 3 ways:

- Users can validate the content of a news article by acting as validators or voters
- Publishers can add their content
- The news consumer can check the truthfulness of the content for a variety of purposes

The Present and Future

As this report shows, the development in the dissemination of fake news has been accelerated by technology, misinformation is not a new phenomenon, however, with the internet we have determined citizens, organisations, and governments must be especially vigilant and educated to determine whether the information they receive and spread is factual.

As a note about the present, this research is by no means exhaustive, the current scenarios in which misinformation is spread are changing as fast as the underlying technologies used to spread it. For the future, further research will need to be performed as technologies mature, we anticipate the maturity of artificial intelligence, video manipulation to create what several have coined deep fakes, even the rise of voice activated devices in our homes could become a future source for scrutiny.

Through civic education and decentralisation we hope to rebuild respect for truth and evidence in our democracies. The internet is an important tool in everyday life; we use it to consume media, to learn, and to communicate among other things. In this report we further delve into the lessons we have learned from Brexit and how to protect EU citizens against fake news.

Introduction

Introduction

Fake News and Its Development

"In August 2016, the 20 most popular of these fake reports generated 8,711,000 shares. This was almost 1.5 million more shares than the equivalent genuine reports reported on 19 major news sites"

"Advances in technology have facilitated rapid, effective modification of authentic news articles and sites[1] into fictitious posts that resemble these authentic stories"

Fake news is a contemporary reference to the communication of false information or misinformation. This is not a new phenomenon, but one that grew in popularity during the 2016 United States' presidential election campaign.[1,2] As the election approached, the internet was flooded with fake election reports, and in August 2016, the 20 most popular of these fake reports generated 8,711,000 shares. This was almost 1.5 million more shares than the equivalent genuine reports reported on 19 major news sites. In contrast, the sharing of authentic news stories in February 2016 amounted to 12 million, and fake reports to 3 million,[3] revealing that the fake news reports were highly targeted to the times that would be likely to have the most effect on the election. This is confirmed by another study focused on identifying trends in shared content originating from 570 fake websites and 10,240 fake news reports on Facebook and Twitter in the period between January 2015 and July 2018. This study also found a colossal rise in interactions with fake news on social media towards the end of 2016.[4] It follows, then, that fake news is generated with the same intentions and utilizing many of the same methods that characterised misinformation in the past, specifically, manipulation, false statements, rumours, and conspiracy theories. However, advances in technology have facilitated rapid, effective modification of authentic news articles and sites[1] into fictitious posts that resemble these authentic stories. This allows misinformation to spread under the guise of legitimate stories or research, and can be diffused to millions of people across social media platforms in seconds.[5]

Other Targets

Fake news is not limited to politics or news, though, as academic and scientific articles are also among the major targets for misinformation. A study endorsed by the Royal Society of Chemistry[6] highlights the dangers of fake science, in which the authors recommend that individuals examine the facts in order to verify their authenticity,[7] particularly as misinformation within scientific fields can lead to fatalities. For instance, the recent proliferation of child illnesses and deaths owing to Measles, Mumps, and Rubella (MMR) can be traced back to global dissemination of misinformation that the MMR vaccine causes autism and should be avoided.

In light of such extreme impacts, a European Union (EU) generated study[6] suggests that scientific literacy needs to be integrated into learning at all educational levels to enable contextual understanding of science and critical thinking regarding vital scientific issues. This action is particularly essential in the current era of technology which increases the speed of disinformation, and, therefore, its highly negative potential impacts. This danger is exacerbated by falsified results in scientific research,[8] which the study went on to find infiltrated even the most prestigious scientific journals. They identified a significant rise in scientific articles being withdrawn prior to publication due to fraudulent content. Misinformation damaging the trustworthiness of scientific research was also found in articles published in open access journals, a relatively new phenomena, fake scientific conferences, and texts published for profit under the guise of neutral study.

Social Media and Fake News

Social media presents its own complications, as it not only allows for much faster dissemination of news, both real and fake, but also fosters opinion based reporting, otherwise known as soft news. Social media is increasingly important for journalists to share, update, and crowdsource information, and therefore remain relevant in the fast news cycle. However, this also incentivises journalists to introduce personal opinion under the guise of objective journalism, as it allows them to push forward 'news' that suits their base. This is clear as those most active on social media also tend to be more focused on satisfying their audience. Twitter orientated journalists, for instance, often develop unique personal news brands that expresses their values and practices and build a community of followers who they also turn to for feedback.[10] Overall, flooding the internet with soft news, adds to the difficulty in identifying fake news, and the tendency for soft news to be developed on social media allows for its much faster spread.

"Scientific literacy needs to be integrated into learning at all educational levels to enable contextual understanding of science and critical thinking"

Twitter and Bots

Twitter's popularity, with its estimated 15.8 million users in the UK in 2016,[11] means that tweets can be disseminated within one to two hours. Tweets can be generated by computer algorithms known as bots,[11] software that completes simple repetitive tasks, as well as human users, which means that fake news on social media is often deployed in a very structured manner. Bots operate under sockpuppet accounts, which use fake identities to set up social media accounts to state and/or engineer opinion. The term sockpuppet is derived from controlling a hand puppet using a sock, and refers to remote management of the false identity as a means to spread misinformation, to lend credibility to a certain perspective or challenge the viewpoint of a specific user community.[12] These accounts, then, which technically violate social media terms and conditions, and in some countries, laws, represent bots and the extent of their proliferation in certain spheres.

Bots serve multiple purposes, from distributing information to researching human beliefs and behaviors. However, they are often employed to undertake malicious tasks, such as abusive communications relating to a particular group and their beliefs, harassment, and spamming. Social media accounts' automated structure makes them an ideal vehicle for employing bots, since they can reproduce themselves and appear to be human, resulting in real users spreading bot-generated information to family and friends.[13] This allows bots to rapidly target specific user groups with a defined message. These messages, then, provide a means to create the illusion of a consensus about a political issue or a politician.[11]

Identifying Fake News

In order to be effective, individuals generating fake news must imitate the style and appearance of information produced by authorities or people their target audience trust.[15] This is particularly important to note, since the learning technology of Twitterbots means their ability to imitate humans increases over time,[11] and their influence on the opinion of others becomes more likely. Understanding how to distinguish between fake and verifiable information is a vital skill, then, and can be developed by identifying the devices employed to generate fake news that will subsequently deceive the recipient.[14] One method of distinguishing whether the content of a tweet is human or bot generated is the timing of the action; humans are more active on Twitter from Monday to Friday and in the daytime, while bot activity has regularity, automated time slots on each day, and it tweets identical content repeatedly, unlike humans.[11] As such, the activity of social media bots, which have been employed aggressively during political events, tends to be limited to just before and just after the event, tweeting and retweeting at programmed times on specific days.[11]

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Fake News Associated With Brexit

The results of the UK national referendum regarding continued membership of the EU were announced on 23 June 2016. 52% voted to leave the EU, while 48% voted to remain.[10] This vote was considered to be driven by a combination of right wing populism, racism, nationalism, and socio-economic inequalities, which mirrored broader discontent throughout Europe.[10] Press coverage of the Leave and Remain campaigns, as well as political and academic critiques, demonstrate considerable bias in reporting. Reporting on Brexit, as well as the claims made by campaigns themselves, also faced a high level of accusations of fake news leveled against both positions by the other. This reveals that while an awareness of fake news is vital, it can also be deployed to cast doubt on facts and to counter opposing opinions, making it even more difficult to discern factual information.

Journalistic Bias
The difficulty in accessing unbiased news is apparent in that even the BBC, which was regarded as a neutral media body, was later found to have been biased in its reporting on EU associated matters prior to 2016; 7% of coverage of the EU was positive, whereas 45% was negative.[15] And, studies conducted since the Referendum have identified substantial BBC bias against Brexit. For instance, the Institute of Economic Affairs[16] found that the BBC selected twice as many Remain proponents than Leave supporters for political forums panels entitled: Question Time and Any Questions, despite the intent of these panels being to respond to questions from the public, of which 52% voted leave in 2016. Journalistic bias is confirmed by one study that found specific key press sources were used by both groups, suggesting that journalistic bias presented each side with a seemingly credible source. Leavers' tweets, for instance, were associated with Daily Express, Daily Mail, and Breitbart, and Remainers often referenced The Guardian, The Independent, The Daily Mirror, and the BBC.[10]

Both campaigns focussed on the same issues, but approached them from different perspectives and with different emphases. They also deployed different tactics as far as how much attention they paid to each issue, figure 1.[17]

"Studies conducted since the Referendum have identified substantial BBC bias against Brexit"

Figure 1: Diverse Emphasis of the Campaign Groups

REMAIN

Migration /
Mobility
10%

Terrorism /
Security
4%

Economy/
Business
54%

Regulations
10%

UK
Sovereignty
22%

LEAVE

Migration /
Mobility
20%

Terrorism /
Security
5%

Economy/
Business
36%

Regulations
10%

UK
Sovereignty
29%
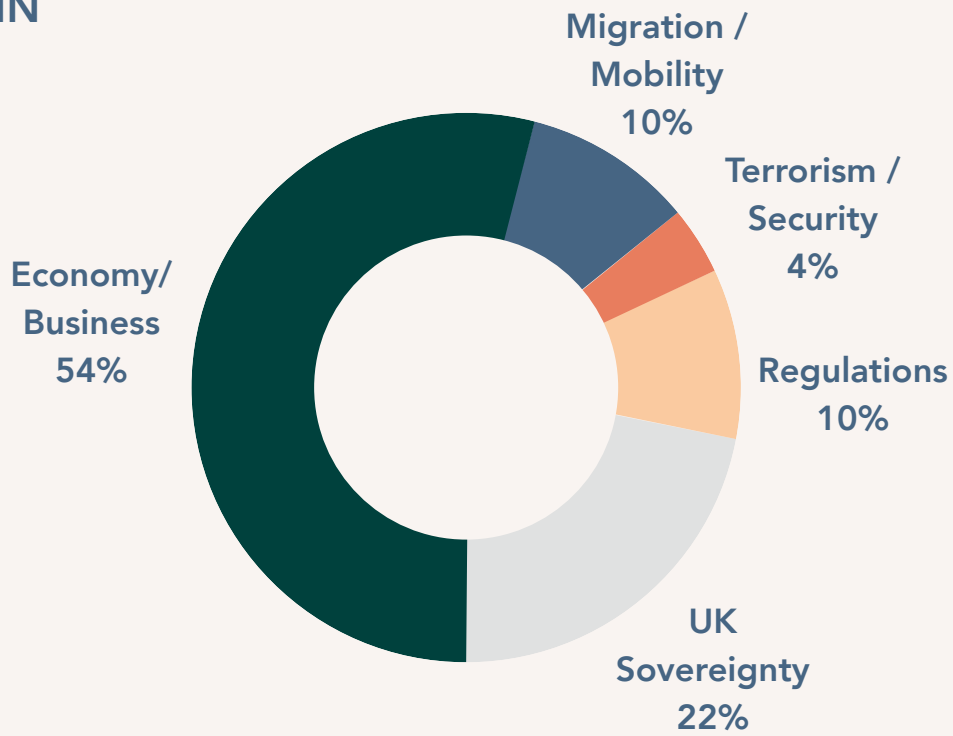
Source: [17]

"This study suggested that misinformation overstating the amount of migration made it difficult, if not impossible, for the public to be informed on the impact of EU migration on the UK economy"

"One study found that false information had been disseminated by Leave produced billboards which proclaimed that Turkey - population 76 million - was joining the EU"

For both groups, the economic consequences of leaving the EU factored heavily into their messaging. For the Remain campaign, it accounted for 54% of activity and 3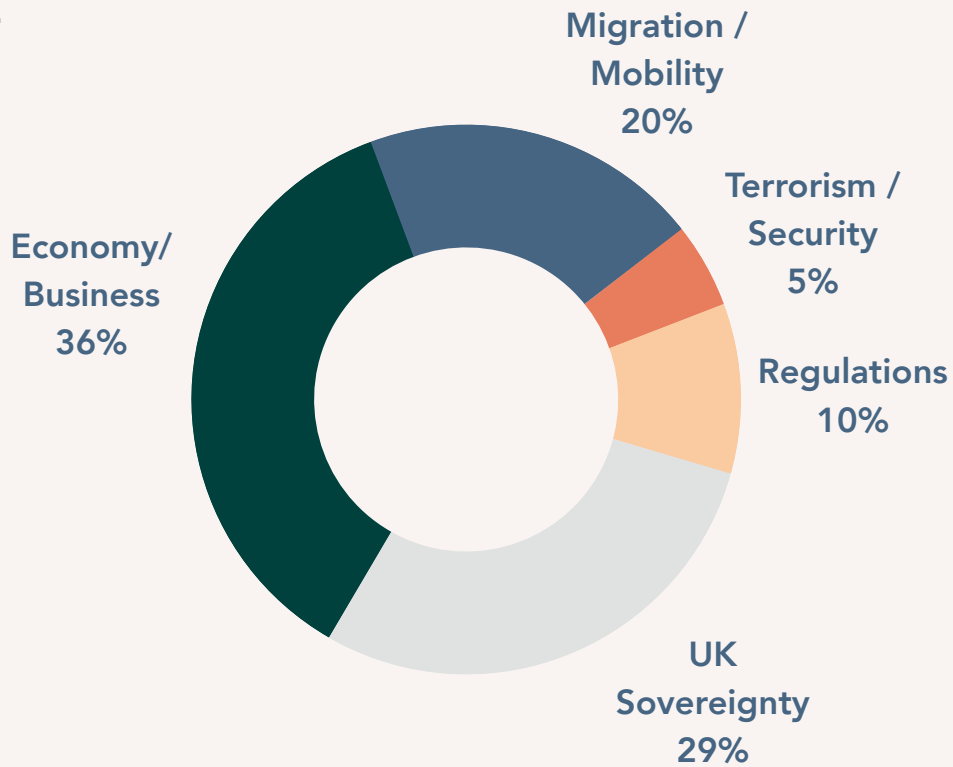6% of the Leave's. The conflicting approaches to topics, though, meant that the Remain campaign was often referred to as fake news and labelled Project Fear by the Leave supporters. However, Sayer,[18] one researcher, regarded the economic statements promoted by Remain as merely warnings of the potential consequences of Brexit, citing the dire economic consequences and reduced mobility that would result from withdrawing from Europe.[17] In this case, it is easy to see how fact becomes harder and harder to identify as opinion colours not only news and claims, but also the news sources that people are likely to trust as claims of fake news spread, often without verified sources to back them up.

Overstating Migration
The Leave group's more diversified focus, figure 1, granted a greater capacity to produce a wide variety of messages. This resulted in two inter-related campaigns, which promoted both a freer, open Britain released from EU regulation and greater protectionism, with less of a global political approach.[17] In their arguments, the Leave group was accused of focusing too heavily on voter anxiety over immigration, and much of their claims on this topic were regarded as fake news by Remainers. The proliferation of immigration focussed reporting is exemplified by a study of 19,367 Brexit related news items published between June 1, 2015 and June 23, 2016.[21] Analysis revealed that of the 12% of all news reports that were Brexit related, the word 'migrant' was prominently featured, often with little distinction being made between EU and non-EU migrants. This study suggested that misinformation overstating the amount of migration made it difficult, if not impossible, for the public to be informed on the impact of EU migration on the UK economy.

The validity of the Leaver's migration/mobility was the topic of other research.[15] One study found that false information had been disseminated by Leave produced billboards which proclaimed that Turkey - population 76 million - was joining the EU; this was considered fake news, however, because progress with Turkey's EU membership was slow, but the billboards implied that it was much faster, with the potential for imminent mass immigration of Turkish nationals into the UK.[15] The Leave faction also promised to boost the failing National Health Service, a critical part of the UK Welfare State according to the majority of the population. They proposed funneling the financial funding currently made to the EU into the NHS instead.[17] However, two studies suggested that the sums quoted were fake. [15][18]

Media Bias and Misinformation

As mentioned before, political bias in journalism is also a hazard on its own. Harding,[15] a journalist whose reporting from 2016 to present is often lauded as ethical journalism, is one such example. Harding's articles have been found to demonstrate considerable bias against Leave. Biased reporting during the Referendum was compounded, as the UK laws and sanctions that mandate political responsibility of officials during general elections do not apply to special elections.[19] While political officials have restrictions and obligations during general elections, media is always able to suggest neutrality. This becomes tricky, since print media is allowed to demonstrate bias and this is reflected by social media content that echoes such reports. These reports and posts are often accepted as plain fact, rather than encouraging users to examine the truth or bias of their statements through debate.[19] Therefore, the period leading up to the Referendum was particularly rife with misinformation, as though bias in the media is always allowed, the reduced restrictions on political officials left very few verified sources for voters to turn to.

Social Media and the Spread of Fake News

Several studies point to the significant impact that social media had on public opinion in the months leading up to Brexit, and therefore, also suggest that due to the amounts of fake news at play, that fake news was successful in swaying public opinion. One study analysed 7.5 million tweets[20] to find that registered UK voters who wished to leave were 1.75 to 2.3 times more active than those who wanted to stay. This trend paralleled press coverage, in which 82% of all newspaper reports favoured the Leave position. Additionally, Leave supporters initiated 83% of all their Twitter interactions with other Leave supporters, while only 46% of Remainers did so, and almost 50% of Leaver activity was retweeting the comments of other Leavers, compared with between 11% and 19.8% of Remainer retweets being to fellow Remainers. The higher level of Leave supported tweeting resulted in their arguments and news, reaching a much wider audience.

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"[The] comment that EU membership costs £350 million a week, written on the side of a bus, appeared in 365 newspapers, was tweeted 32,755 times, and detected in 900 photographs"

"87% of British Members of Parliament now have Twitter accounts"

Similar findings emerged from the study in which 13.2 million tweets produced by 1.8 million users were collected prior to the UK referendum;[22] the highest tweet volume was 2 million, recorded on voting day. In this research, 480,000 users were categorised according to their voting intentions indicated by their tweets. The findings were twofold. First, that traditional news media was a major source of tweets generated, and linked material on Twitter was predominantly found to have been produced by potential Leave voters; and, secondly, that more than half of the 15 traditional news sources were consistently attractive to Leavers, but none was regularly attractive to Remainers. The Leave sites dominated in terms of the strength of links, as well as number of tweets. Despite the amount of activity on Twitter from Leavers, this study found that fake news had only a minor impact on the election result.

Overall, the study suggests that Leave claims were more effective.[22] For instance, their comment that EU membership costs £350 million a week, written on the side of a bus, appeared in 365 newspapers, was tweeted 32,755 times, and detected in 900 photographs. In contrast, a similar Remain statement, that leaving the EU would make every family poorer by £4500 by 2030, was largely ignored, instigating only 9,510 tweets, despite being a headline in 135 newspapers. This finding reveals that campaign slogans that are tailored to the short and punchy style of social media can be far more effective, as after the initial cost of advertising, they will be spread to social media, and promoted directly by supporters.

The influence of social media on global politics was also found to have markedly increased since November 2016, following the election of Donald Trump. 87% of British Members of Parliament now have Twitter accounts, allowing them to bypass journalistic and other media networks and make direct contact with their target audience.[10] The increase in politicians' social media use to directly access their base, when paired with traditional media's turn to social media, flag social media's importance in altering voter's stances and mark it as an ever important political tool.

Twitterbots and the Vote

Social media's increasing importance in politics also means that bots need to be watched for their increased significance, as well. The extent of bot activity during the UK referendum from April to August 2016 was analysed[23] to determine the ratio of bots to human posts and the extent of bot influence on Brexit. One study used a data sample of 10 million tweets. Out of this sample, a network of 13,493 active Twitterbots was identified, but disappeared quickly after the Referendum vote, suggesting a goal of influencing voter opinion. It was also found that political bots could be readily organised into specialist groups and tiers intended to copy tweets generated by users and other bots. This gives them the capacity to swiftly cascade information, disseminating it to a much larger population. Despite all of this, bots were not found to influence the outcome of the Referendum. Analysis of the larger cascades from Bot2Bot, User2User, and Bot2User reveals the major messages that were transferred and a lack of Bot2User transference, accounting for the lack of bot influence on the vote, figure 2.

Figure 2: Large Cascades From Bot to Bot, User to User and Bot to User

—— USER2USER:	.Are you going to #VoteLeave on Thursday? RETWEET this pledge card to show your support!
—— USER2USER:	.Beautiful graphics: Beautiful sentiment #VoteLeave #Brexit
—— BOT2BOT:	.Brexit suddenly looking like the smartest thing Britain has done in 50 years
—— USER2USER:	.CHECK OUT the video the EU tried to shut down. This is how the EU spends YOUR money #TakeControl #'
—— BOT2BOT:	.Haven't said much about #Brexit but I did just leave this on a friend's wall.
—— USER2BOT:	.I'm Dutch and I endorse #Brexit because we can be united only in freedom, sovereignty and rule of l
—— USER2BOT:	.London's Muslim Mayor gives #VoteRemain speech. Men at the front, women at the back. Because segrega
—— USER2USER:	.RETWEET this pledge card to show your friends that you will #VoteLeave on 23 June! #TakeControl #Pro
—— USER2BOT:	.The House of Commons will debate a petition for a second EU referendum on September 5th
—— BOT2BOT:	.This is RemainEU Millionaires jeering at British fishermen #Brexit #VoteLeave
—— BOT2BOT:	.Thursday can be "our country's independence day", Boris Johnson tells #BBCDebate

Source: [23]

Analysing the most popular tweets pushed by bots is useful in understanding the techniques they employed to spread information. The third User2User tweet, for instance, paints the EU as a constricting force that spends UK taxpayer money inappropriately, and the first and eighth promote pledging to vote Leave, which jumps in regularity just before the referendum date. There is also a lot of activity on the sixth User2Bot regarding alleged support from a Dutch Twitter user, endorsing Leave objectives of enhanced sovereignty, freedom, and self-rule. Similarly, the immigration objective, represented by seventh User2Bot cascade, calls attention to a Muslim mayor linked to sexual discrimination. Overall, this information indicates that botnets were designed to echo user sourced information and highly biased comments relating to a particular campaign.[23] The bot networks demonstrated specific patterns, for instance retweeting active users, with sets of bots echoing campaign phrases. These methods pushed out biased campaign content that was characterised by being short and easily shared, accessible on mobile devices, enabling like-minded groups to receive specific fragments.

Foreign Interference
Another study on the influence of Twitter activity on the Brexit Referendum strove to understand the influence of Russia. This study examined 5,811,102 Tweets generated in two periods in June 2016, between 6 and 12 June and between 17 and 23 June.[13] It sought to identify accounts linked to Russia or including pro-Russian content, aiming to discover the nature of the political news stories shared by these accounts. They were categorised as either professionally generated news or extremist, sensationalist, or conspiratorial comments that fell under the category of fake news. The study also analysed YouTube videos shared by Twitter users, to determine if they were verifiable or fake news.

"Overall, this information indicates that botnets were designed to echo user sourced information and highly biased comments relating to a particular campaign"

"The extent of human and automated oppositional and provocative activity in the period immediately before the Referendum was found to be a major concern, as it reinforced the power of social media to alter political outcomes"

The data was broken into categories using a variety of pro-leave, pro-remain, and neutral hashtags to determine the extent and pattern of the use of political bots to intensify communication of the key messages. Only 511 or 6.2% of the 69,627 data analysed were of Russian origin, 0.3% of which were generated by bots. However, 3,650 items were identified as fake news, representing 44% of all of the political content, and was seven times more likely than tweets from Russian sources. Additionally, fake news found in YouTube videos shared on Twitter accounted for 11% of the total. The extent of human and automated oppositional and provocative activity in the period immediately before the Referendum was found to be a major concern, as it reinforced the power of social media to alter political outcomes.[13] The findings of this study regarding fake news, though, conflict other research.[22]

Academic research appears to concentrate on Twitter accounts rather than a range of social media sites, insinuating that Twitter is the most important platform when it comes to both human and bot behaviour relating to political issues. This is reinforced by the high Twitter membership of politicians and politically related institutions.

Facebook's Effect on the Vote

Despite the fact that Twitter was largely regarded as one of the most important social media platform for political activity, Facebook's influence on the UK Referendum was also investigated by the UK House of Commons,[24] as well as some minor reporting by news groups.[24] [25] [26] The House of Commons report, which failed to confirm the alleged Russian involvement in shaping the result of the Referendum, also provided little evidence of the impact of fake news. However, this report did mention some of the contentious statements by Leave and Remain campaigns that were highlighted in other academic studies, but did not indicate that they were of significant influence on the vote; the report focused more on how bots and other devices were employed to transfer information to targeted mass recipients and on the creation of associated fake Facebook accounts.

Facebook Ad Targeting

A BBC News report[27] provided data and several examples of how the Leave campaign strategically deployed Facebook to target certain groups. They found that the official Leave campaign spent £2.7million on targeting Facebook users, including both adverts and bots. It declared that data released by Facebook revealed 1433 messages, but that not all of them could be traced to Leave members, as some were posted by the BeLeave group. Overall, the adverts were viewed 169 million times. The posted adverts, comments, and related graphics included statements such as: 'EU reduces our ability to protect polar bears and limits UK innovativeness, and hence its economic growth.' The NHS featured prominently in more than 140 adverts, which claimed that EU membership cost more than £350 million a week. These adverts went on to say that money could be better spent on improving schools and flood defences. In the last three days before voting, 24 adverts were viewed at minimum 1.96 million times, but potentially as many as 4.2 million times.[27] This data reveals the extent to which Facebook was used by the Leave campaign, and is generally more indicative of its extensive use of social media.

Although the posts are not labelled as fake news, their controversial nature has already been noted in relation to Twitter activity, but this report makes no comment about any similar Facebook activity by Remain, which may be due to a BBC bias for Remain. This report does not directly research the spread of information from Facebook to Twitter, but the mention of campaign slogans published in Facebook adverts that later appear on Twitter in both this and the House of Commons report, strongly suggest this flow of information.

"The official Leave campaign spent £2.7million on targeting Facebook users, including both adverts and bots"

"In the last three days before voting, 24 adverts were viewed at minimum 1.96 million times, but potentially as many as 4.2 million times"
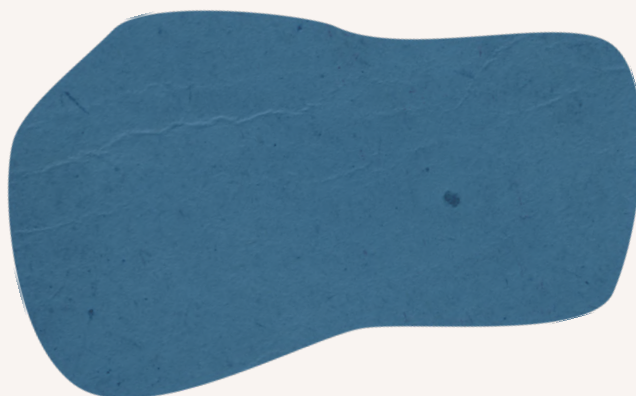
Problems Caused
by Fake News

Problems Caused by Fake News

The previous segment indicated a range of negative consequences that emerge from the spread of fake news. In this section, though, fallout from the spread of fake news is taken beyond the UK to explore political manipulation occurring in two European countries and dangers to public health in Europe.

Political Fallout From Fake News

One study focused on fake news in France, revealed the potential negative outcomes of fake news, especially when taken in congruence with politics.[28] One relatively early case resulted in public criticism of the French President Chirac, and gestures towards the personal and professional damage that may ensue. In this case, a report in the French newspaper, La Croix, on 14 July 2004,[29] stated that a 23 year old woman had been assaulted on the Regional Express Network (RER) in Paris on 9 July. The allegations she made were that five Maghreb men armed with knives attacked her, cut her hair, and drew swastikas on her stomach with a black felt pen. The report caused public outrage, and the government's Interior Minister immediately denounced the attack by the individuals, who they announced were believed to be Jewish; the unprovoked attack was later condemned by President Chirac. The 'victim' gained further support from the media, and received cash for revealing her story, which also mentioned 20 witnesses. She also claimed that she reported the event to a teller at the RER station at Sarcelles.

"The politicians who had spoken out against this incident, including President Chirac, faced widespread embarrassment"

When the police investigated the incident, they initially found no evidence of its occurrence and could not locate any of the witnesses. Further investigation revealed scissors and a black marker in the apartment of the woman's male companion; the pair were arrested, and the woman admitted she had imagined the attack. The politicians who had spoken out against this incident, including President Chirac, faced widespread public embarrassment and were faced with outrage from Jewish communities, who accused the politicians of anti-Semitic prejudice. Despite being anecdotal, this case illustrates how even when a fake report is not directly politically motivated, it can still have political backlash, and ramifications that go far beyond the initial purview of the report.

Fake News in Political Campaigns

More recently, 13 sources of fake news relating to the French presidential campaign of Emmanuel Macron, were revealed.[30] The most prominent of these was published on the website LeSoir.info on 24 February 2017, and proposed that Macron's election campaign had received 30% of its funding from Saudi Arabia; LeSoir.info was identical in design and layout to the authentic and highly reputable Belgian site, LeSoir.be. When the niece of Marine Le Pen, an opposing candidate, read the story, she assumed that it was published by the real Le Soir newspaper, and tweeted about the alleged funding, demanding transparency. This subsequently resulted in 10,000 Facebook shares, likes, and comments. The LeSoir.info domain was revealed to belong to an individual living in the United States, but was constructed so that all of the links to other stories on the fake website led to the actual website, uncovering an alarming amount of professionalism in the deception. Prior to this accusation being identified as fake news, several other newspapers had also published the story. [30] [27] This negatively impacted Macron's credibility initially, and later led to the embarrassment of his political opponent Marine Le Pen. More critically, the democratic French political system was undermined, one of the most common and severe consequences of politically based misinformation. [28]

Misinformation associated with the French election did not end there. More examples of fake news that surfaced during the campaign included: a counterfeit Figaro Poll which reported Marine Le Pen had 32% of the vote, while Macron only had the support of 15% of viewers after a televised debate; a photograph of a severely injured French policemen posted by a Le Pen supporter to highlight increasing delinquency and inadequate current government support, which generated over 7,000 shares but was actually taken in Thailand in 2014 during anti-police riots; and rumors that the French government planned to replace two Christian public holidays with a Muslim and a Jewish holiday, Yom Kippur and Eid al-Adha, respectively. This misinformation, in particular, prompted religious tensions, and led to 6,000 likes, shares, and comments on Facebook, despite the idea merely being promoted by the think tank Terra Nova, and never instituted by the government.[27] All of these later discredited accounts reveal a disconcerting trend around elections that mark these times as particularly prone to misinformation.

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Russia and Fake News

Russia has taken a unique approach to fake news, with the President, Vladimir Putin, introducing a law against fake news. This law imposes large fines on those who demonstrate "blatant disrespect" towards the government, the Constitution, the Russian flag, or the Russian public online; offending websites can be blocked and individuals face fines of US$1500 for disrespect, US$6,100 for any fake news that created mass public disorder, and imprisonment for 15 days for repeat offences. In this case, the Russian authorities determine what constitutes fake news.[31] While it appears that fake news has negative impacts in many countries, this action is regarded by the Moscow Times as a form of internal censorship to inhibit free speech.[32] Therefore, while combating fake news should clearly be a priority for many countries, this does not appear to be an amicable solution.

And, while the Russian state has taken action to limit fake news within its borders, it has also been identified as a major player in creating fake news externally on numerous occasions, most prominent of which are the accusations of manipulating the 2016 US Presidential Election. The US Director of National Intelligence released a report in 2017 that sought to understand the extent of Russian interference in US and European politics. This study found that Russia had used a variety of covert methods to influence the US population's perception of the candidates, including: hacking, troll farms, automated bots, hundreds of thousands of tweets, Facebook and Instagram posts, and over 1,000 YouTube videos. This, however, is not a new practice, as fake news created by Russia to discredit the US has been common practice for at least thirty years. For instance, in 1983 Russia backed a newspaper in India to inform the public that the US had invented the AIDS virus as a biological weapon; subsequently this claim was disseminated by Russian media, which also targeted African countries to pronounce that the US was purposely spreading AIDS in Zaire.[33] Russia, then, is an interesting case to study how they have employed fake news as a strategy against foreign powers.

"Offending websites can be blocked and individuals face fines of US$1500 for disrespect, US$6,100 for any fake news that created mass public disorder, and imprisonment for 15 days for repeat offences"

"This study found that Russia had used a variety of covert methods to influence the US population's perception of the candidates, including: hacking, troll farms, automated bots, hundreds of thousands of tweets, Facebook and Instagram posts, and over 1,000 YouTube videos"

Fake News as Offensive Strategy

"Fake news generated by the Russian state to impact European countries is also a concern that has warranted investigation"

Fake news generated by the Russian state to impact European countries is also a concern that has warranted investigation.[33] Many of these reports center on Russia's invasion of Crimea in 2014. A key piece of misinformation identified by these reports was disseminated as an interview conducted with a refugee. In the supposed interview, the refugee stated that she had watched Ukrainian soldiers nail a three year old boy to a post, torture him to death over a period of hours, and then drag his mother through the town square tied to the back of a tank. The reporter believed her and did not verify the account. A separate independent Russian reporter, though, investigated the incident in the town, and found that no such occurrence had taken place. However, by that time, the original crucifixion report had already been televised and gone viral on social media; its creator was later identified as a political scientist working in the Kremlin. This piece of fake news was used to build support for the capture of Crimea, which benefits Russia as the Sea of Azov represents the major route to the Black Sea by means of the Kerch Strait, figure 3.[34]

Figure 3: Russia Ukraine Tensions

Source: [34]

"These instances reveal the potential of fake news to be employed as a viable strategy to undermine governments and make them more vulnerable to attack"

"This study found that Russia attempted to exert more influence on European politics than any other global nation"

"Russia could then use both media channels and social media accounts to dominate the media and reporting landscape to massively reduce the influence of opposing opinion"

This fabricated interview was just one example of information generated by Russia to justify and gather public support for their invasion of the Crimea Peninsula. Russia's state media employed many techniques to garner support, including using existing Russian Twitter accounts. These accounts were run by government bots to create news that was anti-Ukrainian and pro-Russian. Russia implemented this tactic after the fall of President Yanukovych's government, taking advantage of the period of uncertainty to fuel internal unrest and direct attention away from Russia's invasion. [33] [35] These instances reveal the potential of fake news to be employed as a viable strategy to undermine governments and make them more vulnerable to attack.

A study by Karlsen,[36] one researcher of Russia's online tactics, provides further evidence of Russia's attempts to undermine Europe through extensive networks used to deliver fake news. Karlsen analysed 40 annual reports that the Secret Service Departments of 11 western countries prepared between 2014 and 2018. This study found that Russia attempted to exert more influence on European politics than any other global nation. The main Russian objective was identified to be to weaken NATO powers and EU influence, for the overall goal of removing the sanctions imposed on Russia in 2014, after its annexation of Crimea. Additionally, diverse objectives relating to individual countries were found.

To achieve these goals, discontent was generated using all forms of media, giving Russia access to the majority of the population in the countries they were targeting. This was done with the intent to divide the population, subvert trust in democratically elected leaders, and, eventually, result in tensions between members of NATO. While the target of most of these objectives were outside of Russia's borders, much of the creation and dispersal of fake news initiated in Russia. This allowed them to utilize the complete control over television broadcasts and other propaganda channels, including the internet and paid western journalists, that the state holds. Simultaneously, Russia would give instructions to editors-in-chief about the topics and key phrases that they must employ when generating news items. Russia could then use both media channels and social media accounts to dominate the media and reporting landscape to massively reduce the influence of opposing opinion.

"Twitter's release of nine million tweets generated by fake accounts associated with a Russian troll factory, showed that these were employed to create divisions between national audiences"

"While the government espouses the elimination of fake news internally to support the existing regime and potentially censor any discord, they also extensively employ it externally, sow unrest in Europe and divert attention away from strategic moves"

Deepening the Divide

Russia was also found to harass and gain control of social media users' accounts and profiles in order to map, and then infiltrate, social and professional networks to further spread misinformation to specific groups and beyond.[36] Twitter's release of nine million tweets generated by fake accounts associated with a Russian troll factory, showed that these were employed to create divisions between national audiences, such as British and French. The emergence of new Russian supported organisations integrated into social media were also found,[36] whose purpose was also to spread fake news. Overall, the diversity of tactics deployed reveals an in-depth understanding of how to employ online networks to disseminate misinformation.

These sources indicate that the Russian position on fake news satisfies two opposing targets. While the government espouses the elimination of fake news internally to support the existing regime and potentially censor any discord, they also extensively employ it externally, sow unrest in Europe and divert attention away from strategic moves. The high level of activity and funding behind this state machine demonstrates the power of fake news to manipulate political power and create tensions between established alliances of other countries. These examples also indicate the urgent need to find ways to eliminate fake news and the bots that spawn it.

Health Misinformation

While political manipulation is a major focus of fake news in Europe, scientific misinformation that impacts health and survival is also rampant. A report by a leading UK pediatrician[37] revealed that she is increasingly questioned by parents of young children about whether the MMR vaccine can cause autism, a statement that is the direct result of fake news disseminated on social media. Parents who question her along this line of reasoning either ignore or are unaware of the fact that not vaccinating can cause brain damage and death in severe cases.[37] Eleven of the thirty EU/EEA countries recommend or require vaccination for children under 18 months for one or more of the most infectious diseases: diphtheria, tetanus, pertussis, hepatitis B, poliovirus, Haemophilus influenzae type b, measles, mumps, rubella and varicella.[38] The World Health Organization (WHO) also recommends vaccinations for young children, going so far as to provide a schedule starting at birth.[39]

Vaccine Hesitancy

The UK based Royal Society for Public Health[40] released a report highlighting how the herd instinct affected parents, leading to wide-spread avoidance of vaccinations. The report found that up to 50% of parents with children under five years had received negative messages on social media. This messaging, as well as fake news in the press, dominated the decisions made by parents. Herd instinct led many parents to base their decision not to vaccinate their young children on those around them, despite publicly available data from established global bodies, such as the WHO, with reports stating that between two and three million deaths are avoided annually due to vaccination programmes and that vaccination initiatives have eliminated diseases such as smallpox, reduced the incidence of myelitis, measles and hepatitis B in the UK.

"Failure to vaccinate means less financial support can be directed to other health issues"

"Even portions of the population who have been vaccinated are negatively affected by others' decision not to vaccinate through the unintended consequence of reduced antibiotic effectiveness"

Fallout from Fake Science

Falling vaccination rates not only lead to higher rates of preventable diseases, but also spurs another critical issue: the rise in global antibiotic resistance. Antibiotic resistance threatens the effectiveness of antibiotic use to cure diseases in the future;[40] vaccination against specific diseases prevents infection and eradicates the need for prescribing antibiotics when they occur. In other words, failing to vaccinate children, who may then contract the disease, potentially leads to two risks: that children will contract a disease, and that the disease will subsequently be incurable due to overuse of antibiotics. This happens as the chances a disease will develop an antibiotic resistant strain increases the more the disease is exposed to the antibiotic. And, this is a viable threat even with viruses such as influenza, which despite not being cured by antibiotics, can lead to secondary infections that require antibiotics. Influenza, though, can be avoided through vaccination, and, in this case, would mitigate the need for antibiotics entirely. Therefore, proper vaccination can not only reduce or eliminate the disease they protect against, but can also help retain the effectiveness of antibiotics against other infections.

From a governmental economic perspective, then, vaccinations are an important tool for maintaining general health and directing public health funding to conditions that cannot be prevented. Failure to vaccinate means less financial support can be directed to other health issues. Therefore, misinformation about vaccinations, which currently influences a high percentage of Europeans, has multiple consequences,   not merely the impact on each child's future health and welfare. Even portions of the population who have been vaccinated are negatively affected by others' decision not to vaccinate through the unintended consequence of reduced antibiotic effectiveness. To counter this, some countries have introduced legislation mandating that all children under a certain age must be vaccinated.[38]

Origins of MMR Fake Science:

The origins of current parental fear of vaccination can be traced back to a report by Andrew Wakefield published in 1988 in The Lancet, a UK medical journal. This report suggested a link between the MMR vaccine and autism,[41] even though the official data demonstrated the effectiveness of the vaccine, as indicated by the low incidence of MMR cases.[40] The study findings were also later discredited, as the conclusions drawn by Wakefield's research team were based on a sample of 12 cases, and therefore unrepresentative of the whole population.[41] Ten of the original research team of 12 withdrew their support due to insufficient data, and The Lancet rescinded the article when it was discovered that Wakefield had failed to disclose financial interests in the results of the study. Media coverage of the report, though, had already led to rapid dissemination, and generated irreparable damage to confidence in the vaccination process.41 Consequently, by 2004, less than 80% of UK children under two years old were vaccinated.[38] [40]

"Ten of the original research team of 12 withdrew their support due to insufficient data, and The Lancet rescinded the article when it was discovered that Wakefield had failed to disclose financial interests in the results of the study. Media coverage of the report, though, had already led to rapid dissemination"

The ramifications of such misinformation continue to be demonstrated by recent reports. For example, 13,120 cases of measles were reported in the EU/EEA between July 2018 and June 2019; the highest numbers were in France, Italy, Romania and Poland, representing 18%, 14%, 12%, and 11% of the total, respectively. However, when rates per million population were compared with an average of 25.3, Lithuania, Bulgaria and Slovakia were found to have rates of between 271.3 and 143.8.42 The account also stated that underreporting of cases was suspected by some countries, and when the data for the period 2018 to 2019 is examined, rapid increases can be observed in 2019, implying that the after effects of misinformation is still leading to under vaccination and indeed this misinformation is spreading ever further table 1.[42]

"By 2004, less than 80% of UK children under two years old were vaccinated"

"When the data for the period 2018 to 2019 is examined, rapid increases can be observed in 2019, implying that the after effects of misinformation is still leading to under vaccination"

Table 1: Data Extract Demonstrating Trends in Numbers of Measle Cases Reported

Country	2018							2019					Total cases	Cases per million	Total lab-positive cases
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May			
Austria	6	1	3	6	0	4	1	25	33	1	27	38	145	16.4	134
Belgium	22	3	11	14	4	6	6	21	88	70	36	99	380	33.3	285
Bulgaria	1	7	0	0	0	0	0	0	51	185	279	281	804	114.0	750
Croatia	16	3	1	0	0	0	0	0	1	0	0	2	23	5.6	23
Cyprus	0	0	0	0	0	0	0	0	1	0	1	3	5	5.8	4
Czech Republic	12	4	7	4	7	16	19	43	147	186	83	.	528	49.8	455
Denmark	0	0	2	2	0	0	1	2	5	4	2	1	19	3.3	19
Estonia	0	0	0	0	0	0	0	3	6	2	0	6	17	12.9	17
Finland	0	0	3	0	0	1	7	3	3	0	2	0	19	3.5	19
France	191	81	29	38	76	61	54	123	208	313	339	543	2 056	30.7	1 182
Germany	94	54	29	24	13	10	10	102	71	128	70	51	656	7.9	511
Greece	155	38	18	4	2	0	1	0	3	7	12	6	246	22.9	114
Hungary	0	0	0	0	0	0	1	2	5	4	2	6	20	2.0	20
Iceland	0	0	0	0	0	0	0	0	1	6	0	0	7	20.1	7
Ireland	2	5	17	2	1	1	0	2	18	23	6	10	87	18.0	54
Italy	317	147	79	57	82	58	76	180	171	227	306	223	1 923	31.8	1 583
Latvia	3	1	1	0	0	1	2	0	0	0	1	0	9	4.7	9
Lithuania	0	1	1	0	0	8	20	12	73	250	221	116	702	249.9	702
Luxembourg	0	0	2	0	0	1	0	0	0	15	7	1	26	43.2	26
Malta	0	5	0	0	0	0	0	0	0	3	13	11	32	67.3	32
Netherlands	10	1	4	0	0	0	2	4	4	10	1	5	41	2.4	41
Norway	0	0	3	0	0	0	0	0	1	7	3	3	17	3.2	14
Poland	12	13	19	9	21	79	114	123	240	265	197	178	1 270	33.4	820
Portugal	3	1	3	3	2	24	12	2	2	2	0	3	57	5.5	53
Romania	111	285	92	72	65	81	130	261	75	188	108	148	1 616	82.7	1 221
Slovakia	67	257	87	28	16	38	50	43	37	70	105	44	842	154.7	639
Slovenia	3	0	0	0	1	0	0	0	0	0	6	8	18	8.7	18
Spain	24	14	7	4	4	1	6	11	11	23	67	63	235	5.0	215
Sweden	3	3	2	4	1	0	3	0	1	4	6	4	31	3.1	28
United Kingdom	100	82	54	16	21	26	11	79	75	95	93	52	704	10.6	704
EU/EEA	1 152	1 006	474	287	316	416	526	1 041	1 331	2 088	1 993	1 905	12 535	24.2	9 699

Source:[42]

"With only four countries having 95% vaccination rates or above,[42] and fake news on MMR has also resulted in some politicians failing to support such programmes"

"Italy is 1 of only 4 EU/EEA countries reporting rubella cases in the period 2017 to 2018; a total of 24 cases were documented"

The ongoing incidence of measles is the consequence of low vaccination coverage, with only four countries having 95% vaccination rates or above,[42] and fake news on MMR has also resulted in some politicians failing to support such programmes. For instance, in Italy, Matteo Salvini, the former Interior Minister, was quoted as stating that the 10 mandatory vaccines were ineffective and potentially harmful.[43] Following this, a recent report declared that Italy was suspending the requirement for proof of the 10 vaccinations to qualify for entry to preschools and nursery schools.[44] This is particularly concerning as Italy is 1 of only 4 EU/EEA countries reporting rubella cases in the period 2017 to 2018; a total of 24 cases were documented.[42] An academic study found that the failure of Italy and some other European countries to accomplish immunisation requirements was due to a combination of false information spread by mass media, which lowered the confidence of parents in the importance and safety of vaccinations, a reaction against their compulsory nature, and lack of knowledge by some healthcare professionals.[38]

Alarmingly, this fake science appears to be spread in an active manner. For instance, another report suggests that religious concerns have been cited as a reason to avoid vaccination, which can generate anti-religious backlash as well. For example, parents in Muslim countries are being deterred from vaccinating children due to false claims that pig tissue may have been use in vaccine production.[65] In other countries rumors of mercury contamination have been used to increase fears and arguments against the high profits made by drug companies and have been employed to dissuade parents from vaccinating their children.[45] These methods of spreading fake news suggest that while the initial fear can be linked to the debunked Wakefield study on links with autism, this fake science has taken on a life of its own, and is being spread rampantly under other misinformation that often doesn't have a debunked study to back it up.

Overall, from 2017 to 2018, a 30% increase in the number of measles cases was recorded globally, while in Europe the total number more than doubled, and there were three-fold growth in reported cases in the UK.[37] It is believed that the escalation of reported cases can be linked back to social media as a means of spreading misinformation about vaccination. This is largely due to the fact that many parents and young people use the internet as their sole or major source of health information. Therefore, anti-vaccination posts,[37] such as those cited in Italy, rapidly go viral globally and are credited as being accurate, but are frequently not validated by internet users accessing another source.

Blockchain Solutions to Fake News Dissemination

Blockchain Solutions to Fake News Dissemination

Given the dangers found in the spread of fake news, we turn to empirical research to interrogate the capacity of blockchain to offer potential solutions to the problem. A current initiative employed in Finland to prepare future young voters to distinguish between facts and fake news, Faktabaari, is also examined for its contributions to a solution. The potential to combine these two systems into one strong mechanism to eliminate the fake news at play in election cycles and societal attitudes, is then addressed in the conclusion.

Blockchain Overview (Distributed Ledger Technology Overview)

"This level of security and verifiable history, previously not available, makes blockchain particularly useful for authenticating information"

Blockchain offers transparency, cryptographic security, decentralisation, and immutability, which means that information stored in a block cannot be altered after it has been validated.[46] This level of security and verifiable history, previously not available, makes blockchain particularly useful for authenticating information. The Distributed Ledger Technology (DLT) that blockchain uses makes it virtually impossible for the information to be altered or hacked, as each added block has an integrated cryptographic hash of the previous block. This makes blockchain virtually impossible to modify retrospectively due to the timestamp that is inherent to the unique hash of each block, as the entire blockchain would have to be edited simultaneously. If news sites would take advantage of blockchain technology, their information could not be mimicked and presented as the original source of established media, as in the case of LeSoir.info.

Figure 4: Visualising a Blockchain
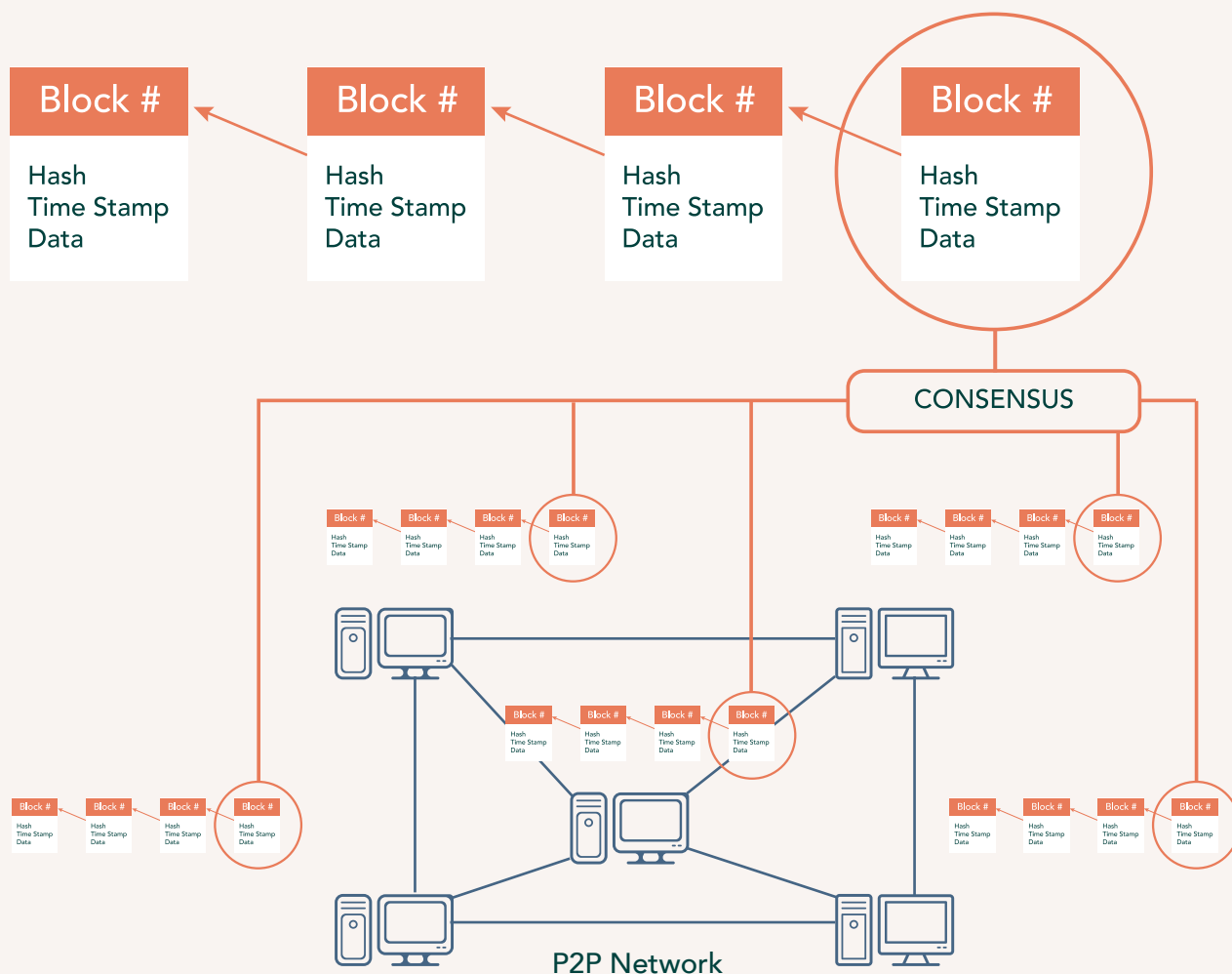
Source:[48]

"Blockchain enables users to trace the source of the news down to every part of the content and who it has been shared with"

Blockchain presents a possible solution to the spread of fake news as it can restore transparency. Blockchain enables users to trace the source of the news down to every part of the content and who it has been shared with. This is a vital intervention for the journalistic talent associated with hard news, as well as being valuable to economic, political, and social news, which has declined as more media personalities focus on soft news.[49] [50] Making a publically accessible history of edits, based on blockchain technology, could incentivise more authors to contribute hard news and hold authors and sites more accountable for the news they publish.[51] There are several major blockchain initiatives that present potential solutions to the current issues posed by fake news.

Potential Blockchain Solutions to Fake News

Blockchain Enabled News Platforms

The maintenance of archives, which blockchain insures, is extremely beneficial to journalists. These archives allow journalists to demonstrate the quality and depth of their previous articles, as well as prove these articles' authenticity. This is particularly useful, as writers often have considerable difficulty accessing their articles after an established publication ends and there is no longer a viable website.[50] Therefore, blockchain enables journalists to provide verifiable proof of their skills and gives them a backlog of work.

"Blockchain enables journalists to provide verifiable proof of their skills and gives them a backlog of work"

Elimination of Traditional Advertising

Beyond providing access to articles even after a news site goes out of business, blockchain provides more methods for combating journalistic bias. One such method is to eliminate traditional paid advertising. Paid advertisers often maintain the power to require certain opinions to be published, especially as many news groups are now owned by large companies, such as Amazon or individuals like Rupert Murdoch. Another perverse incentive of the advertising model stems from the direct link between impressions and revenue, causing (online) media to optimise for maximum page views. This, in combination with the ability to measure performance in realtime and automatically optimise content, tends to favor revenue generating content rather than quality content.

"Another perverse incentive of the advertising model stems from the direct link between impressions and revenue, causing (online) media to optimise for maximum page views"

The logical solution is a platform in which the owners and readers of articles contribute to maintaining the authenticity of news through their own financial contributions. This idea somewhat replicates the way that print newspapers were partly funded by readers purchasing the publication, which allowed professional journalists to be paid to create hard news.[50]

However, the decline in the number of physical newspapers sold has substantially reduced the potential for print advertising revenues. Additionally, the online era has flooded the market with a huge number of digital news sites, and suggests that limited advertising budgets are spread over all media. This results in low revenues per site, especially for non-established news outlets, and lends to high rates of corporate failure. If online advertising revenues were replaced by small contributions from a large number of online readers, digital news companies could become sustainable, without having to write to appease funding biases.

"If online advertising revenues were replaced by small contributions from a large number of online readers, digital news companies could become sustainable, without having to write to appease funding biases"

A browser called Brave, characterised by having no traditional paid advertisement scheme, strives to do just this. Brave uses an Attention Token called BAT - Basic Attention Token - as its cryptocurrency to incentivise readers and writers. The platform enables users, publishers, and advertisers to communicate directly. Advertisers pay the network to display adverts, the publisher is rewarded directly from the network based on the degree of Attention, and users are rewarded every time they read an advert. In this system, journalists are compensated by receiving tokens with a defined value, relying on the quality of the story and readership generated.   Readers can also directly award tokens to their favourite writers.[57]

"The inclusion of direct reader support of journalists suggests a new business model that allows journalists to be more independent from publishers"

The inclusion of direct reader support of journalists suggests a new business model that allows journalists to be more independent from publishers. Journalists can then avoid working for established popular news brands which may require biased reporting, as they are rewarded directly for quality and truthfulness instead. This model further eliminates journalism that relies on altering stories to promote a specific view, or fake news, because the blockchain mechanism prevents unauthorised changes to the original article by both publishers and hackers.[57] Therefore, reader's are able to verify that the articles have not been tampered with due to pressures from publishers or funders.

This aspect of the relationship could add to the sustainability of the news outlet, as it generates more loyalty.   Reader loyalty can be further encouraged by incentivising readers to contribute news for some form of compensation, such as cryptocurrancy.[50] This causes readers to become more active stakeholders in digital publications. Overall, increased reader engagement enables the site to gain more paid followers as well as increasing the quality and the range of hard information available.[51]

Governance, Management, Traceability

The Interplanetary File System (IPFS) allows for the storage of digital content, including news articles, in a secure manner while remaining accessible to users. Blockchain, then, can be simultaneously employed for governance, management, traceability of the originator, and to track any changes made to the original.[54] Each file within the IPFS system and every block comprising it is associated with a unique cryptographic hash, so that the network can find the computer nodes storing any specified file;[55] as noted in section 3.1, the nodes ensure that the network has no single failure points, because if any block on the chain does not match, then the entire blockchain is invalidated. Each network node has a specific category of content, and files can be found by means of the decentralised Inter Planetary Naming System (IPNS). Unlike the internet, which retains web pages for an average of 100 days, and HTTP protocol, which can only load one file at a time, IPFS can download multiple files, is decentralised, and can preserve documents.[55] Therefore, when paired with blockchain technology, IPFS enables a much more powerful system of tracking and storage than older systems.

The long term storage of files is important in eradicating fake news, as it ensures that the authenticity of the originals can be traced, and eradicates the ability of the origin of fake news to simply disappear. This system can also be used to reduce false statements and research findings in scientific papers, particularly those associated with open source journals, as it creates a map of edits that cannot be corrupted.[56] Blockchain enabled news platforms expand the ability to track published information even further, as they have the capacity to keep permanent records of all newsworthy events in the distributed ledger. This benefits journalists as well as future research and studies.

When IFPS is linked to a blockchain, all of the steps from receiving a journal article to peer review and publishing are captured, and the information is encrypted similarly to the representation for publishing a book, figure 5. [54 55 56]

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"The long term storage of files is important in eradicating fake news, as it ensures that the authenticity of the originals can be traced, and eradicates the ability of the origin of fake news to simply disappear"

Figure 5: Combining IPFS and Blockchain for Governance and Management of Publications
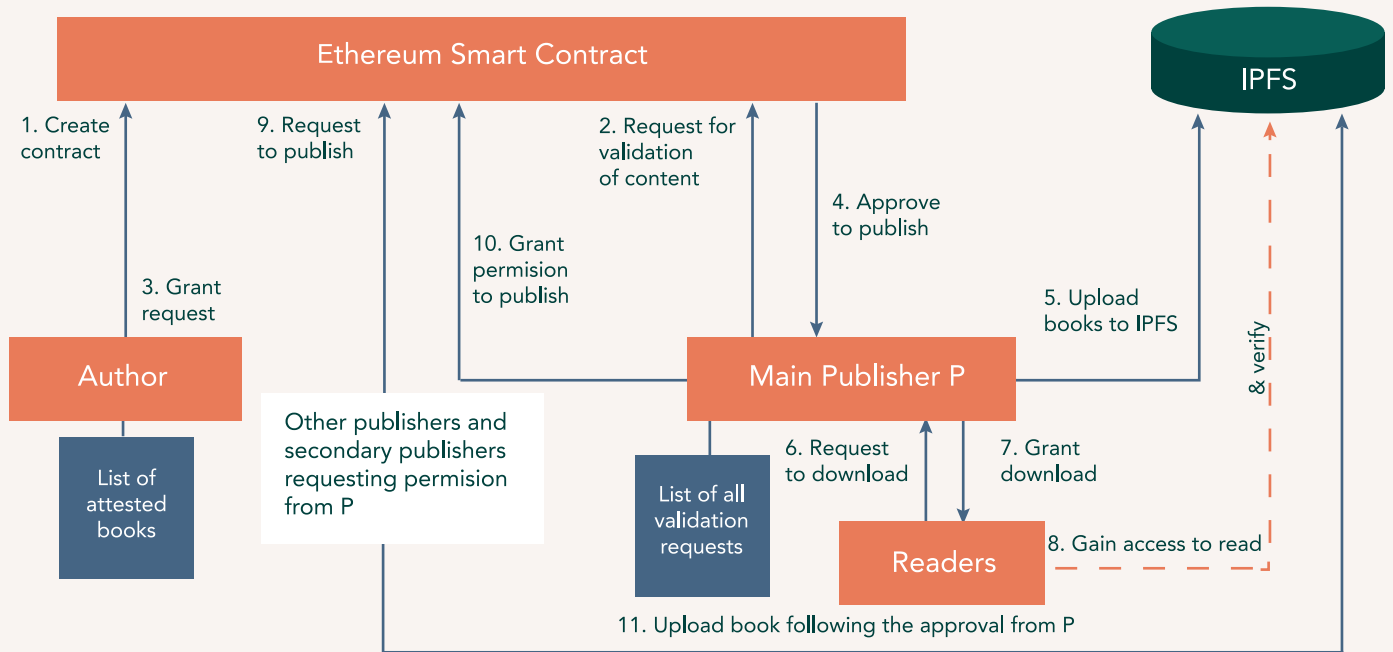
Source: [54]

For a journal article to be traced using blockchain, the author, journal, and peer reviewers all receive smart codes. Their actions are guided by specific rules allowed by their respective smart code; each action is recorded, cryptographically signed, and transparent in the publication network.[56]

Blockchain Applied

Highly reputable established news outlets are already experimenting with blockchain to eliminate fake news from their published reports. For instance, the New York Times and its partner companies began to implement the proof of work/concept in July 2019, and are trialling it until December 2019 in an attempt to enhance trust in digital archives. The company began to use blockchain to encrypt photographs and videos with details of the date, time, and location of their origin, as well as how they were edited and published. When these videos or photographs are displayed on other digital news sites, group chats, or identified by means of search engines, a set of signals can reveal its presence.[58]

"When the editor receives the photograph, they check that it has not been altered during the transfer by checking the cryptographic hash of the photograph that is generated and transferred at the same time as the photo"

Photographs are currently a specific focus for blockchain verification, and an academic study conducted in 2017[59] demonstrates how this system operates in practice. The study is based on a real photographer, who was employed by the Birmingham Mail. The cryptography process gave the photographer a public key to the system and the editor one of the few private keys, figure 6. The editor then used a program to produce both the public and private keys based on random numbers.

The data is encrypted with a shorter key that can then generate cybertext to convert it back into plain text in the decryption process, as shown in the figure above. In this system, referred to as public key cryptography, the photographer alerts their editor to the photograph they have taken by using the editor's public key to conduct the encryption process. The editor, who possess the paired private key, is the only individual who can decrypt the photographer's message. When the editor receives the photograph, they check that it has not been altered during the transfer by checking the cryptographic hash of the photograph that is generated and transferred at the same time as the photo. The editor can then match the value of the hash to authenticate the picture.

Hashes have five major properties that make them so effective:

1. the same message always generates the same hash;
2. the message hash is calculated very quickly;
3. the message to hash process is unidirectional, in other words the hash cannot generate the message;
4. any slight alteration to a message changes the hash;
5. and, no two messages will calculate the same hash.[59]

"Put simply, this tool can prove beyond a doubt the provenance of any source of digital media by using blockchain technology, even going as far as identifying attempts to mislead by using images out of context"

Therefore, by using hashes and keys, editors are able to verify the photos they recieve.

The concept devised for authenticating journalistic photographs was also the basis of a distributed App (dApp), named Provenator. Provenator checks the origins of digital media using the combination of blockchain and cryptographic tools. However, additionally Provenator currently exists on the IPFS network, which is ideal as IPFS also checks the authenticity of resources using cryptographic tools.   Provenator identifies the origins of the resource by means of Preservation Metadata Implementation Strategies (PREMIS), which is comprised of four units:

1. objects, single digitally preserved information items including bitstreams, files, intellectual entities;
2. events referring to an agent or object that is known to the system;
3. agent, which may be an organisation, a person, or software;
4. and statement of rights or permission.[59]

Put simply, this tool can prove beyond a doubt the provenance of any source of digital media by using blockchain technology, even going as far as identifying attempts to mislead by using images out of context.[59]

Machine Learning and Blockchain

Geppetto, a platform developed by Digital Ventures (DV), combines machine learning and blockchain to enable the public to test the veracity of news stories. An article's URL can be pasted into Geppetto, which then scrutinises it for false information. Natural language processors and machine learning then analyse the article's contents to provide a legitimacy score for the publisher and article validators; a continuous learning algorithm enables the system to retain its effectiveness despite the rapidly changing nature of online content. This platform, also referred to as the Veracity Engine or Truthfulness Engine, also allows users to act as validators or voters directly and publishers can add their content directly, in order to provide proof of validation for their readers.[52]

When developing the platform, DV, identified three key categories of fake news:

1. all of the content was fake;
2. the title was fake, but the bulk of the article valid;
3. and the title real, but content all false.

The natural language processor identifies the first two types by judging the alignment between title and content, while the third is more difficult to analyse. This is due largely to personal opinion and emotions that separate hard news from soft news.

To tackle the problem of identifying the level of inaccuracy of an article, Artificial Intelligence (AI) models are used to detect these features and rank the article using a probabilistic validity scale; high scores indicate high fact articles, but are then further scrutinised for fact patterns that will indicate actual or false features. Instead of using humans to validate articles, which would be extremely labor intensive, blockchain allows for a performance ledger of the outcomes, which AI continuously updates the data hashed and referenced on Geppetto. The creators of Geppetto also invite publishers, users and validators to contribute to diminishing the degree of fake news in the media and incentivise them to do so.[53]

"A continuous learning algorithm enables the system to retain its effectiveness despite the rapidly changing nature of online content"

"Instead of using humans to validate articles, which would be extremely labor intensive, blockchain allows for a performance ledger of the outcomes, which AI continuously updates the data hashed and referenced on Geppetto"

Civic education

While blockchain technologies have substantial potential to eliminate fake news and related bot activity, continuous civic education must also be addressed as found through research the wider public will take one source of media as fact. For instance, Faktabaari, a fact checking system created which is part of The International Fact Checking Network,[60] relies on Trendolizer, a tool that collects and classifies news articles, which are then automatically given a source code by the integrated software. Trendolizer software has the capacity to check the authenticity of stories before they go viral. Additionally, when Faktabaari identifies fake news, it shares a screenshot of the story branded 'FALSE' in large red letters.[61]

"Trendolizer software has the capacity to check the authenticity of stories before they go viral"

Faktabaari, which is Finnish for Fact Bar, was initiated in 2014 as a response to the need for accurate information available to the public regarding EU elections. It is owned by a Finnish transparency NGO, but managed by volunteers, including professional journalists, EU experts, research professionals, and technical experts.[62]

In a volunteer led organization, blockchain could be of particular use since the transparency of an NGO is of the utmost importance to ensure contributions are being utilized correctly. One primary challenge is tracking and recording volunteers working hours. Using blockchain technology transparency and its real-time updating features will help verify and authenticate these volunteer hours. Additionally, audit trails could be provided for various stakeholders with the correct permission levels ranging from governments to funders to eliminate the possibility of fraud. With blockchain technology in place, an organization would also be able to devise an incentive system for the volunteers where they would receive cryptocurrency giving them a further stake in the organization.

Faktabaari was also an active fact checker for the 2019 European Parliamentary elections, and offered training in schools and universities to enable their employees and associates to check the authenticity of facts, themselves. Fake news related to 2 million immigrants receiving pre-paid Mastercards posted by a populist party was identified using Trendolizer.[63] Faktabaari also has an advanced cybersecure publishing platform and all its publications are accessible to the public via the Creative Commons licence.[63]

Cryptography

Although this system does not use blockchain there are some similarities in the context that codes are assigned to news articles and its publications are secure by means of its open source coding system. As indicated, the Faktabaari misinformation activity has reached beyond merely checking facts related to elections to public education regarding misinformation and how to detect it. The Voter Literacy Project is integrated into the national curriculum and pupils learn how to check facts and how to use critical thinking to appraise the veracity of what they read online. A traffic light system and definitions of different types of misinformation are employed to support young people and adults to judge whether content is true, not true, or a combination of both. The features of a true statement are that it is written in the appropriate, very specific context and other supporting data is available, whilst an untrue statement is characterised by opposing expert opinion, but the motivation for the untruth is not determinable. A statement that is part true and part false is often one that comprises over simplification of the facts and cannot be verified or confirmed. False information can also be a consequence of defective information, misinformation resulting from a mistake, by deception that a hoax realising disinformation or by damage originating from gossip, classified as bad information.[64]

Conclusion

Conclusion

The overall research strove to determine what Brexit could teach us about fake news and how to further protect EU citizens from the spread of misinformation. To do so, data was gathered and analysed on reporting during the period just before and immediately following the 2016 United Kingdom European Union membership referendum, commonly referred to as Brexit. The referendum, and the issues surrounding it illustrate the nature of politics today, as well as the spread of information that influences them.

Our research revealed that many people believe sources they find on the internet without verifying them. While there are some existing models promoting civic education and engagement to eradicate fake news, we found that they do not have the infrastructure to track and tackle fake news at the level it is being produced and spread. Therefore, we believe that combining such educational efforts with technological resources such as blockchain, IPFS, machine learning, and natural language processing, can be helpful in minimizing and eradicating fake news.

Most current internet use is based on centralized servers which can only store data for a limited time and open information up to unverified changes or censorship, as governments need only access to the centralized server in order to control the content that their entire public is able to access. However, IPFS makes the web completely distributed by running it on top of a peer-to-peer network, one of the underlying principles of decentralised technology. IPFS also allows for the storage of digital content, including news articles, in a secure manner while still being accessible to users. Simultaneously blockchain may be employed for governance, management, tracing the authorship and changes. This system has the ability to identify the origin of content, the nature of the original entity, for instance a photograph, video or text, the event it represents, and the rights and permissions of the participants. IPFS, then, creates a manner of storing and tracking information, while also mitigating the potential for censorship.

Additionally, all archived information is not only accessible to authors and consumers, but can be employed to create further authentication tools. These archives are useful not only to track the history of publication, but can be used by language processors and machine learning algorithms to improve their identification of fake news. This enables articles to be identified as fake news before their spread and at a much greater rate than could reasonably be verified by humans.

Therefore, while educational programmes to promote critical thinking are still vitally important, many of these organizations could also adopt blockchain to improve their tracking and identification of fake news. When approached from both sides of the issue, people are empowered to analyse the information they consume, but also given the tools to make researching their sources a relatively quick and easy process. Overall, we hope that blockchain can be adopted to encourage informed decisions for EU citizens, from politics to their health.

About dGen

After Gen X, characterised by big societal shifts, Gen Y, better known as millennials, and the digital native Gen Z, the decentralised generation will grow up in a future shaped by different dynamics and technological developments. AI, blockchain technology, and IoT will individually bring disruption to many industries, but it's at the crossroads where we expect our whole socio-economic fabric to change.

dGen is a not-for-profit think tank based in Berlin, Germany. We focus on how blockchain technology can contribute to a decentralized future in Europe and what this might mean for people, society, private entities, and the public sector over the coming decades.

Emerging technology focused on decentralising society will shape the next part of the twenty-first century; The dGen will grow up with opportunities for borders to fade and traditional networks to dissipate. Meanwhile, most blockchain developments are still in the early stages; focusing on building solid products and exploring regulatory requirements to create a fertile yet safe environment for companies and investors. The industry is focused on solving the big topics right now, while we encounter a lot of great ideas in the blockchain community about adoption. It's time for those ideas to find a purpose and for the real decision-makers in the world to learn what decentralisation will mean for them.

We're working with a team of researchers exploring how decentralisation will shape our future. Our insight reports focus on specific topics and industries to drive ideas for adoption in Europe. If you're researching how decentralisation is shaping our future, and would like to get involved, please get in touch at dgen.org.

Contributors


Jake Stott

Before founding dGen, Jake was originally a partner at Signal Ventures, investing in blockchain tech. In late 2017 he founded hype partners to help build and nurture ecosystems for blockchain projects and has worked with many top 100 projects. With these combined experiences he is able to distinguish legitimacy, necessity, and nonsense in this space.

Nick Dijkstra

One of the founders of dGen and with a rich background in tech, Nick knows how to build organisations from scratch and can transform ideas to great tech products. As a former Product Manager at LiveIntent and Director of Customer Success at Avari he shipped software to a user base over 15% of the US population and has organised 200+ events in Berlin. As the COO at hype partners, he is currently helping top-tier blockchain firms strategise their market approach.
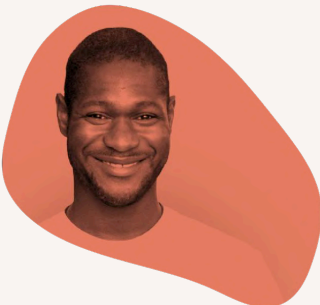
Tristan Littlejohn

Tristan's work as an entrepreneur and founder lets him experiment with the ways we shape our systems for the future which are economically beneficial, socially responsible and create greater social impact.

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Maggie is a writer, researcher, and editor. Trained in literature, critical theory, and gender studies, they are now exploring the ways that technology is changing the landscape of human interaction.

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