



# Quantifying Media Influence and Partisan Attention on Twitter During the UK EU Referendum

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**Abstract.** User generated media, and their influence on the information individuals are exposed to, have the potential to affect political outcomes. This is increasingly a focus for attention and concern. The British EU membership referendum provided an opportunity for researchers to explore the nature and impact of the new infosphere in a politically charged situation. This work contributes by reviewing websites that were linked in a Brexit Tweet dataset of 13.2 million tweets, by 1.8 million distinct users, collected in the run-up to the referendum. In this dataset, 480,000 users have been classified according to their “Brexit” vote intent. Findings include that linked material on Twitter was mostly posted by those in favour of leaving the EU. Mainstream news media had the greatest impact in terms of number of links tweeted, with alternative media and campaign sites appearing to a much lesser extent. Of the 15 most linked mainstream media, half show a substantially greater appeal to the leave camp, with two of them very much so. No mainstream media had a consistent appeal among remain supporters. Among the sites that were highly favoured by one voter valence or the other, the leave sites had by far the greatest impact in terms of number of appearances in tweets. Remain-preferred sites were less linked, and dominated by explicit campaign sites. Leave-preferred sites were more numerous linked, and dominated by mainstream and alternative media.

## 1 Introduction

“Post-truth politics” [6] and “weaponized relativism”<sup>1</sup> describe strategies by which misleading information can be used to shape debates, redirect attention and sow confusion in order to influence political outcomes. In recent times, concern has been raised about the opportunities social media may be creating for use of these strategies, and the consequent undermining of democracy.

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<sup>1</sup> <https://www.theguardian.com/commentisfree/2015/mar/02/guardian-view-russian-propaganda-truth-out-there>.

Furthermore, social media can create a skewed or biased information environment that may affect voters' perspectives. This has rightly become the focus for research [20], which is starting to yield insights. The British EU membership referendum ("Brexit") provided an opportunity to explore the nature and extent of social media impact in a politically charged situation.

In this work, we explore the informational materials that appeared in tweets about Brexit. With the aim of deepening our understanding of who exerted an influence in the run-up to the referendum, and how their influence played out, the work is organized around the following research questions:

**RQ1: Who were the most prominent information sources in the Brexit debate on Twitter?** Specifically, what domains were most linked?

**RQ2: Is there evidence of differential media sharing patterns between leave and remain supporters?** In what ways are leave and remain campaigns responding differently to opportunities afforded by the Twitter medium? How are readers responding to materials?

**RQ3: What influence has partisan and misleading material had?** Who is supplying biased material? How effective have these materials been?

Key to the work presented here is a foundation of a list of around half a million Twitter users accurately classified according to their Brexit vote intent; "remainers" expressed or indicated their intention to vote for the UK to remain in the EU, and "leavers", their intention to vote "leave". The work explores similar territory to that covered by Faris *et al.* [4], who analyze mainstream media and asymmetries in the context of the 2016 US general election; we extend this with a contrasting political scenario in a different country, and through our focus on Twitter. Moore and Ramsay [15] analyse mainstream media behaviour in the run-up to the referendum; our work builds on theirs by exploring how the behaviour they discuss relates to a medium's partisan appeal. Previous work has also shared valuable evidence of Twitter partisan activity in the run-up to the referendum [9, 16]; our voter classification enables us to bring an additional perspective and rich possibilities for exploration of partisan dynamics.

The aggregate data on which this work is based are available for download.<sup>2</sup>

## 2 Related Work

The work presented here is set against a backdrop of increasing awareness of the ways in which the internet and social media are changing society. Social media have been widely observed to provide a platform for fringe views. Faris *et al.* [4]

<sup>2</sup> <http://www.dcs.shef.ac.uk/~genevieve/publications-materials/brexit-domains-shared-materials.ods>.

showed that social media seem to amplify more extreme views, with materials linked on Twitter being more outré than the open web, and on Facebook even more so, a finding echoed by Silverman [19]. Barberá and Rivero [2] and Preotiuc-Pietro et al. [18] both show that Twitter users with more ideologically extreme positions post more content than those with moderate views.

Researchers also report consistent asymmetries in the way these changed conditions play out. Allcott and Gentzkow [1], during the run-up to the 2016 US presidential election, found 115 pro-Trump fake news stories, which were shared a total of 30 million times. They found 41 pro-Clinton fake news stories, which were shared a total of 7.6 million times. This disparity is again echoed in Silverman's [19] work.

There is little evidence of a difference in the way information consumers of different political valences respond to materials that might account for asymmetry [1,4]. Instead, Faris *et al.* suggest that in the case of the 2016 presidential election it was the cooperative behaviour of pro-Trump media themselves that led to an advantage, in a phenomenon they dub “network propaganda”. This raises questions about the reach of such a network or the conditions under which it might arise elsewhere, and its relationship to political views if any.

A body of work [12,13] has begun to explore Brexit opinion and sentiment as expressed on Twitter. Howard and Kollanyi [9] share our interest in propaganda, but their work concerns “bots” and the role of automated activity on Twitter. Their group have also specifically investigated Russian involvement in Brexit [16]. Bastos and Mercea [3] also study the impact of bot activity, and present some observations about the nature of the content linked by the bots. They state that such materials are likely to be user-generated, tabloid-style emotionally orientated materials. Such work highlights the presence of organized attempts to influence. Matsuo and Benoit<sup>3</sup> focus on differences in the dialogue between leave and remain camps. Moore and Ramsay [15] also highlight differences in the tone of the different campaigns.

The role of Twitter misinformation in the context of the 2016 US presidential election has attracted much research attention, as previously discussed. Less research has reviewed similar situations in other countries. Ferrara [5] focuses on the anti-Macron disinformation campaign in the run-up to the 2017 French presidential election. A series of white papers from the Oxford Internet Institute explore junk news and misinformation in a variety of countries' elections [7,8,10,11,17]. Such work offers the opportunity to find patterns that extend beyond local situations. This work forms a part of that effort.

### 3 Methodology

The basis of the work is a large collection of tweets collected using the GATE Cloud Twitter Collector<sup>4</sup>, a tool that allows tweets to be gathered according

<sup>3</sup> <http://blogs.lse.ac.uk/brexit/2017/03/16/more-positive-assertive-and-forward-looking-how-leave-won-twitter/>.

<sup>4</sup> <https://cloud.gate.ac.uk/shopfront/displayItem/twitter-collector>.

to search criteria as they appear, and processed using GATE<sup>5</sup> text processing pipelines to enrich the tweets with relevant background information, including the EU membership stance of the author. The method is described more fully by Maynard *et al.* [14]. In the next section we describe collecting the tweets, then after that the user vote intent classification.

Throughout the work we make use of Partisanship Attention Score (PAS), first introduced by Faris *et al.* [4]. This metric is a simple ratio of the number of times a source is linked by one valence of user, for example leavers, versus the other valence. In this work we use “leave-PAS” to describe a PAS in which leave linkers outnumber remain linkers, and “remain-PAS” to describe a PAS in which remain linkers dominate. We have grouped sources into five sets; those in which a PAS is greater than 30:1 (one leave set and one remain set), those in which the PAS is greater than 3:1 (leave and remain) and those with a more balanced PAS of less than 3:1. The 30:1 and 3:1 ratios were selected heuristically—throughout the work we are careful to reflect on how that choice might affect the results.

### 3.1 Tweet Collection

Around 17.5 million tweets were collected up to and including 23 June 2016 (EU referendum day). The highest volume was 2 million tweets on Jun 23rd (only 3,300 lost due to rate limiting), with just over 1.5 million during poll opening times. Of the 2 million, 57% were retweets and 5% replies. June 22nd was second highest, with 1.3 million tweets. The 17.5 million tweets were authored by just over 2 million distinct Twitter users (2,016,896). The work presented here focuses on a subset of these, covering the month up to and including June 23rd. Within that period, there were just over 13.2 million tweets, from which 4.5 million were original tweets (4,594,948), 7.7 million were retweets (7,767,726) and 850 thousand were replies (858,492). These were sent by just over 1.8 million distinct users. The tweets were collected based on the following keywords and hashtags: *votein*, *yestoeu*, *leaveeu*, *beleave*, *EU referendum*, *voteremain*, *bremain*, *no2eu*, *betteroffout*, *strongerin*, *euref*, *betteroffin*, *eureferendum*, *yes2eu*, *voteleave*, *voteout*, *notoeu*, *eureform*, *ukineu*, *britainout*, *brexit*, *leadnotleave*. These were chosen for being the main hashtags, and are broadly balanced across remain and leave hashtags, though the ultimate test of the balance of the dataset lies in the number of leavers and remainers found in it, which is discussed below.

Most URLs found in tweets have been shortened, either automatically by Twitter or manually by the user, which has the side effect of obfuscating the original domain being linked to. For this work we expanded the URLs in tweets using the following approach. From manual analysis of the URLs we accumulated a list of 18 URL shorteners or redirect services: [shr.gs](http://shr.gs), [bit.ly](http://bit.ly), [j.mp](http://j.mp), [ow.ly](http://ow.ly), [trib.al](http://trib.al), [tinyurl.com](http://tinyurl.com), [ift.tt](http://ift.tt), [ln.is](http://ln.is), [dlvr.it](http://dlvr.it), [t.co](http://t.co), [feeds.feedburner.com](http://feeds.feedburner.com), [redirect.viglink.com](http://redirect.viglink.com), [feedproxy.google.com](http://feedproxy.google.com), [news.google.com](http://news.google.com), [www.bing.com](http://www.bing.com), [linkis.com](http://linkis.com), [goo.gl](http://goo.gl), and [adf.ly](http://adf.ly). All URLs from other domains were considered to already be expanded. (A small number of minor URL shorteners have gone unexpanded due to the long

<sup>5</sup> <https://gate.ac.uk/>.

tail in this large tweet set and the necessity of manually identifying shortening services.) When we saw a shortened URL it was expanded, either by following HTTP redirects or using the API of the shortener, recursively until the resulting URL no longer pointed to a domain in our list of shorteners.

### 3.2 User Vote Intent Classification

Classification of users according to vote intent was done on the basis of tweets authored by them and identified as being in favour of leaving or remaining in the EU. Such tweets were identified using 59 hashtags indicating allegiance, given in the online experimental materials<sup>6</sup>. Hashtags in the final position more reliably summarise the tweeter's position, so only these were used. Consider, for example, "is Britain really #strongerin? I don't think so! #voteleave".

This approach was evaluated using a set of users that explicitly declared their vote intent. A company called Brndstr<sup>7</sup> ran a campaign offering a topical profile image modification in response to a formulaic vote intent declaration mentioning their brand. This enabled a ground truth sample to be easily and accurately gathered. On these data, we found our method produced a 94% accuracy even on the basis of a single partisan tweet (where three are required, an accuracy of 99% can be obtained, though only 60,000 such users can be found, as opposed to 290,000 with at least one partisan tweet). The Brndstr data itself, consisting of around 100,000 users of each valence, was also used to supplement the set, raising the accuracy further, and resulting in a list of 208,113 leave voters and 270,246 remain voters. Table 1 gives detailed statistics for three conditions; one matching tweet found for that user, two found or three found. "Total" is the total number of users found with that number of matching tweets. "Brndstr found" is the number of those users found in the Brndstr set, and so able to be evaluated. The remaining figures refer to that set, providing an accuracy for the total list of users found using the given minimum number of partisan tweets.

There may be a case for using a threshold of two hashtags in order to produce a more balanced set of leavers and remainers, but this would disproportionately exclude remainers with more moderate feelings (if the number of hashtags can be seen as an indicator of this). The resulting set is somewhat slanted toward remainers, demonstrating the obvious; that Twitter isn't a representative sample of the UK population, who voted to leave the EU to the order of 52%. However, leavers were more vocal and apparent in the data presented below, contrary to what we would expect if the higher number of remainers had affected the result. It is possible that some users changed their mind about how to vote after making their Brndstr declaration, but voters making an online declaration of their vote intent are perhaps those less likely to vacillate, and the work can in either case be seen as an exploration of the behaviour of those who held a particular allegiance during the time period studied.

<sup>6</sup> <http://www.dcs.shef.ac.uk/~genevieve/publications-materials/brexit-domains-shared-materials.ods>.

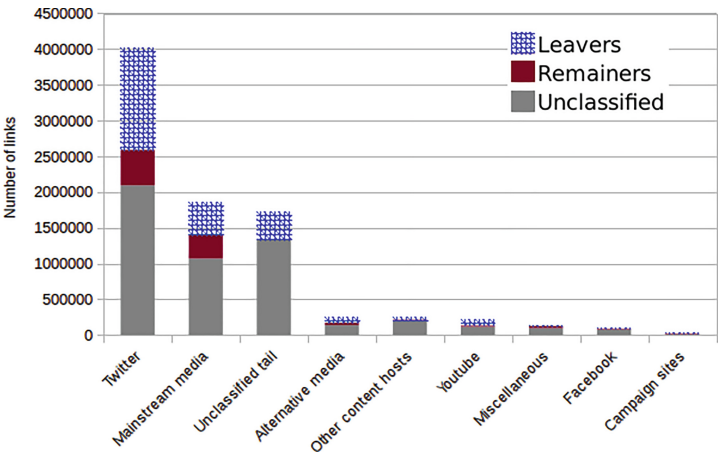
<sup>7</sup> <http://www.brndstr.com/>.

**Table 1.** Brexit classifier accuracy

	Total	Brndstr found	Of found correct	Accuracy	Cohen’s kappa
Leavers, 3#	34539	1142	1129	0.987	0.972
Remainers, 3#	26674	603	594		
Leavers, 2#	49080	1368	1350	0.984	0.966
Remainers, 2#	50972	901	882		
Leavers, 1#	114519	1935	1801	0.943	0.885
Remainers, 1#	175042	1744	1667		

4 RQ1: Who Were the Most Prominent Information Sources in the Brexit Debate on Twitter?

Across the whole corpus, the top 100 most posted domains were manually grouped into high level categories, and the number of links in tweets to domains in each category are shown in Fig. 1. The dominant domain to appear was Twitter itself, appearing whenever anyone posts an image, as well as when they link to another tweet. After that, the greater proportion of the links are to items in a wide variety of mainstream news media. “Other content hosts” refers to smaller content platforms such as Instagram; YouTube and Facebook are listed separately. Finally, smaller amounts of material are linked from referendum campaign sites and alternative media. (Alternative media range from publications that are nearly mainstream through to conspiracy sites and fake news.) The “long tail” of a further 17,000 less linked domains that haven’t been manually classified are included in the chart to give a quantification of the unknown; note that this unknown section is likely to contain many more small alternative media,



**Fig. 1.** Types of links posted

blogs etc. than mainstream media. Also only domains that were tweeted at least once by a user that has been classified for vote intent were included. The actual number of domains mentioned in the set is much greater.

The graph broadly agrees with Table 1 of Narayanan *et al.* [16]. We are also able divide each count into three parts, indicating the proportion of tweets in that section by unclassified users, remainers and leavers. It is evident at a glance that remainers were tweeting less linked material, since their representation is smaller. Also there were fewer remainers in the unclassified tail (that is, the column of unclassified sites, not the unclassified users), suggesting perhaps a preference for more popular sites on the part of remainers. It is unknown how many leavers, remainers and undecideds constitute the unclassified users (the grey bottom section of the columns) but there's no particular reason why the classified users wouldn't give a representative impression.

Figure 2 shows the sites that had the most impact, in terms of total number of times they appeared in tweets in the Brexit dataset. These were almost entirely mainstream media, mostly UK media, with the exception of the remain campaign site “ukstronger.in” and the UK government domain. The graph gives total counts of appearances of the most influential domains, colour coded by partisanship attention score (PAS); the ratio of links from leave voters to remain voters or vice versa. Platforms such as Facebook, where the site doesn't author the content, are excluded. Only link appearances in original tweets are used in this graph (not appearances in retweets or replies). Tables 2 and 3 in Appendix A give a longer list of sites. The full set is also available for download<sup>8</sup>.

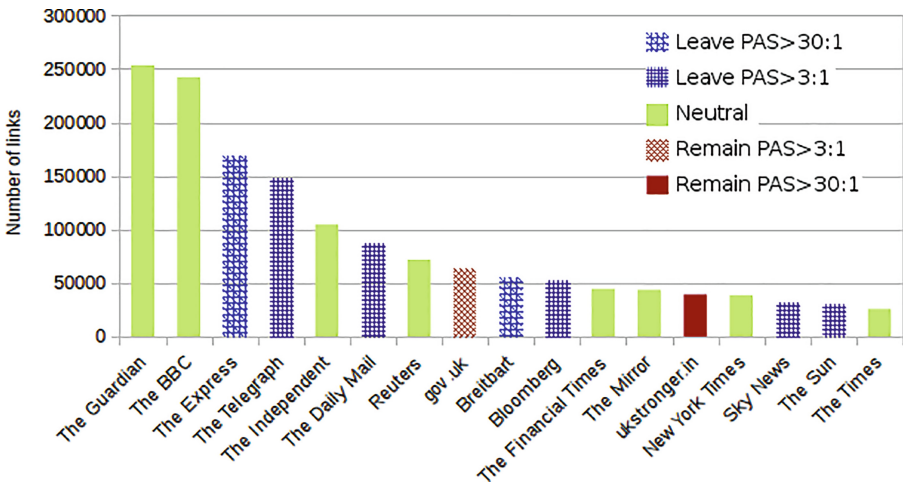


Fig. 2. Number of appearances of high impact sites

<sup>8</sup> <http://www.dcs.shef.ac.uk/~genevieve/publications-materials/brexit-domains-shared-materials.ods>.

On page 13 of Moore and Ramsay [15] a similar graph shows the number of referendum-related articles published by UK media. The number of Brexit articles published by a medium shows a strong correlation to its link presence on Twitter (0.71). In fact, the Express has been somewhat less taken up on Twitter than its engagement with the subject might predict; Fig. 4 and its discussion later in the paper may offer further insights on this point.

*RQ1 Discussion.* It is evident that mainstream media were the dominant source of linked materials in the Brexit discussion on Twitter, with the six most influential domains all being British mainstream media as shown in Fig. 2. Smaller in influence but nonetheless significant were alternative media, with Breitbart appearing in ninth place in Fig. 2, user-shared content on other content platforms such as Facebook, and campaign sites. This suggests a continuing important role for traditional media, though leaves questions about how social media, and indeed alternative media, may interact to popularize certain materials and influence the focus. It is also apparent that the most popular domains were either neutral in their appeal or appealed to leavers, with only two smaller sources, the government and the “Stronger In” campaign, appealing to remainers. This subject is taken up more fully in the next section.

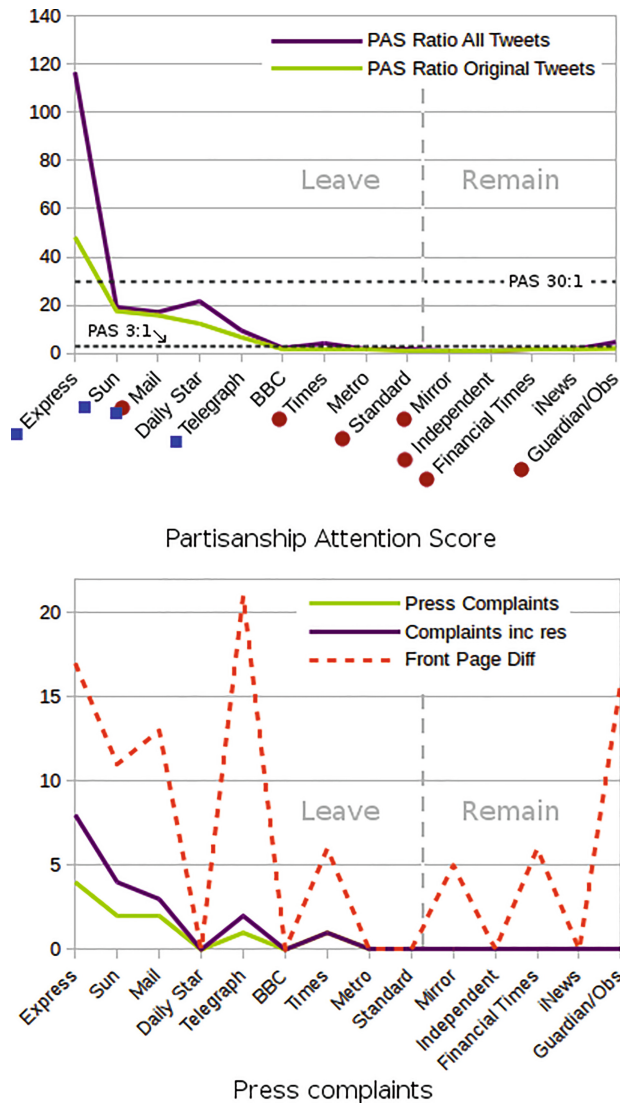
## 5 RQ2: Is There Evidence of Differential Media Sharing Patterns Between Leave and Remain Supporters?

Figure 3a shows British mainstream newspapers ranked from left to right in order of their leave PAS ratio (ratio of appearances in leave tweets against appearances in remain tweets). PAS ratio is shown on the graph; however, for those media with negative leave PAS ratios, the remain PAS ratio has been plotted (ratio of appearances in remain tweets against those in leave tweets). In this way, both leave and remain media can be shown commensurately on the same graph. The point at which the PAS ratios switch direction is indicated with a vertical dashed line. The extreme right of the graph, therefore, shows the newspaper with the highest remain PAS ratio (The Guardian/Observer combined). Two horizontal lines indicate PAS ratios of 3:1 and 30:1. PAS ratios for link appearances in all tweets and just original tweets are shown.

Several British newspapers declared their allegiances regarding Brexit, reportedly giving media supporting the UK leaving the EU an audience of around 4.8 million, while those in favour of remaining in the EU reach just over 3 million<sup>9</sup>. Stance information is included in Fig. 3a in the form of coloured marks—a blue diamond for leave and a red circle for remain. Both marks appear for the Mail because the Daily Mail shares its domain with the Mail on Sunday. The Daily Mail were in favour of leaving the EU, and the Mail on Sunday, with a

<sup>9</sup> [https://www.huffingtonpost.co.uk/entry/which-newspapers-support-brexit\\_uk\\_5768fad2e4b0a4f99adc6525](https://www.huffingtonpost.co.uk/entry/which-newspapers-support-brexit_uk_5768fad2e4b0a4f99adc6525).





**Fig. 3.** PAS (a) and Press Complaints (b) for UK Mainstream News Media

slightly lower circulation, were in favour of remaining. Several other domains include the Sunday edition of the newspaper, but only in the case of the Mail do these have different Brexit stances. The Times and the Standard appear with leave PAS scores (to the left of the dashed line) despite a remain allegiance. The PAS scores however are low.

There are various explanations for why remain media materials might have a lower PAS, indicating appeal to both sides of the debate. In order to gather

more information about the nature of the materials linked, and the extent of their partisanship, press complaints about stories that could impact on voters’ feelings about EU membership in the months preceding the referendum were examined. Figure 3b provides this information, in a graph in which media are ordered according to their PAS, to match the preceding graph. Cases where a story appeared in print and online are counted one time only. The green line indicates the number of upheld press complaints for that medium. The purple line also includes the number of complaints for which a resolution was found. The majority of press complaints regarded articles that were anti-immigration in their focus. The graph also includes an orange dashed line plotting data taken from Moore and Ramsay [15]. They provide data about the number of leave and remain front pages published by media in the weeks leading up to the referendum. The number plotted (“bias”) is the magnitude of number of leave front pages minus number of remain front pages, as shown in the equation below. The point at which the number flips from indicating leave bias to remain bias is again indicated with a dashed line on the graph. Zero-scoring media are those for which Moore and Ramsay do not provide statistics.

$$bias = \sqrt{(leave - remain)^2}$$

Figure 4 presents counts of sites according to their PAS status. A threshold of 20 total original tweets by leavers and remainers was applied, in order to exclude sites for which too little evidence was available to classify them. The graph shows peaks to either extreme, despite the stringent 30:1 criterion, reinforcing previous researchers’ findings that extreme content tends to proliferate on social media [2, 4, 18, 19]. On the right we see the actual link counts to the sites. Twitter mentions have not been included, since they give a large, uninformative boost to the neutral count. Were other content-neutral platforms to be excluded, this count would be lower still. (Table 2 in Appendix A gives the top 20 sites in each PAS category, in terms of total links; a number of content neutral platforms can be seen there to illustrate the point). This conflation of content-neutral with ideologically neutral does not affect the observation that the extremes no longer

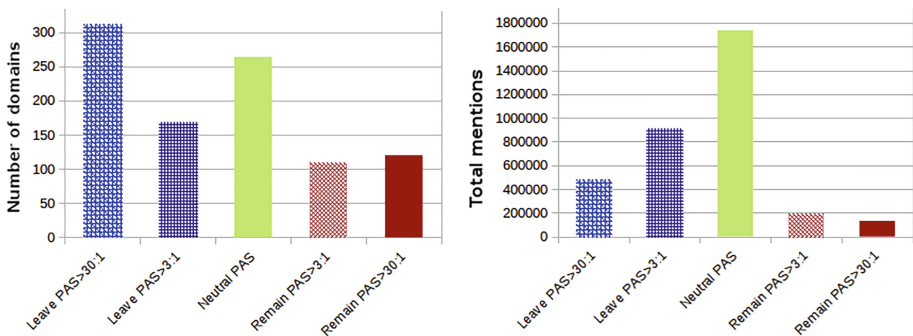


Fig. 4. All domains vs total mentions by PAS of domain

outnumber the moderate sites. It seems most Twitter users prefer less extreme materials of those on offer; a suggestion that would also explain the Express being somewhat less popular than its Brexit engagement would seem to warrant, as discussed above.

*RQ2 Discussion.* The data have shown that all of the media that declared their support for the remain cause were broadly neutral in their appeal, with the exception of the Guardian/Observer, who, when retweets and replies are counted, has a leave PAS greater than 3:1. The media that declared their official support for leave all to varying extent appealed more to leavers. This brings to mind Faris et al.’s [4] conclusion from their study of the 2016 US presidential election that mainstream media ranging from left to centre right show more investment in principles of neutrality. The Brexit question cut across the political spectrum, although in terms of media stance, the left-leaning papers favoured remain and the right, leave. However, it is also possible that leavers engaged with remain materials for other reasons. In order to gather more data, we reviewed press complaints data, and also compared front page partisanship data from Moore and Ramsay [15]. It is interesting to note that PAS seems to echo upheld press complaints better than it does partisanship as indicated by front pages. There are prominent cases where media published many stories in keeping with their Brexit stance, but without attracting press complaints; namely the Telegraph and the Guardian. Materials supportive of a particular stance don’t *per se* seem to draw partisan attention—the PAS of both these media is low.

This is important in correctly interpreting Fig. 2. The medium with the biggest impact is the Guardian, which published many pro-remain articles. So in this sense, there wasn’t a lack of attention to pro-remain materials, and if the colour coding of the graph were based on the “front page diff” used above, the impression created would be quite different. PAS captures something different. Manual review of the tweets suggests that Guardian articles tend to be factual in tone, and attract critical engagement from leavers. Express articles tend to use emotive and suggestive language, and seem to attract less discussion. Moore and Ramsay’s analysis [15] gives much information about the rhetorical styles employed by the press in the run-up to the referendum. Circulation size does not explain the number of complaints received, with the Express having less than half the readership of any of the four largest media.<sup>10</sup>

## 6 RQ3: What Influence Has Partisan and Misleading Material Had?

We saw in Sect. 5 that high PAS scores show a potential relationship with upheld press complaints, and that polarity of PAS is a good indicator of the stance of the source, as determined from press front pages. In this section we use PAS

<sup>10</sup> <http://www.pressgazette.co.uk/nrs-national-press-readership-data-telegraph-overtakes-guardian-as-most-read-quality-title-in-printonline/>.

scores of greater than 30:1 to select sources that may be misleading for further examination. Sites of either camp with at least 1000 total mentions in tweets in the dataset and at least 50 tweets, retweets or replies by leavers or remainers were manually analysed. We present the sites divided into 4 categories; mainstream media, alternative media, campaign sites and other sites. “Others” includes for example personal blogs or special interest websites not primarily focused on Brexit.

Figure 5 shows that remain PAS > 30:1 sites are dominated by explicit campaign sites. As we would expect given the data above, among leave influencers we see more mainstream media—note that the only high PAS mainstream media were leave media; namely the Express. We also see a much greater role for alternative media in the leave campaign. The total impact of leave PAS > 30:1 media was 389,000 mentions. For remain it was 70146 mentions, or 18% of the PAS > 30:1 impact. All sites with a PAS higher than 30:1 and more than 5000 mentions are shown in Fig. 6. The Express dominates, with the US alternative medium Breitbart in second place. As indicated above, remain sites are mainly campaign sites. Other leave sites are media ranging from alternative to conspiracy, plus the campaign site “[voteleavetakecontrol.org](https://voteleavetakecontrol.org)”. A longer list can be found in Table 3 in Appendix A.

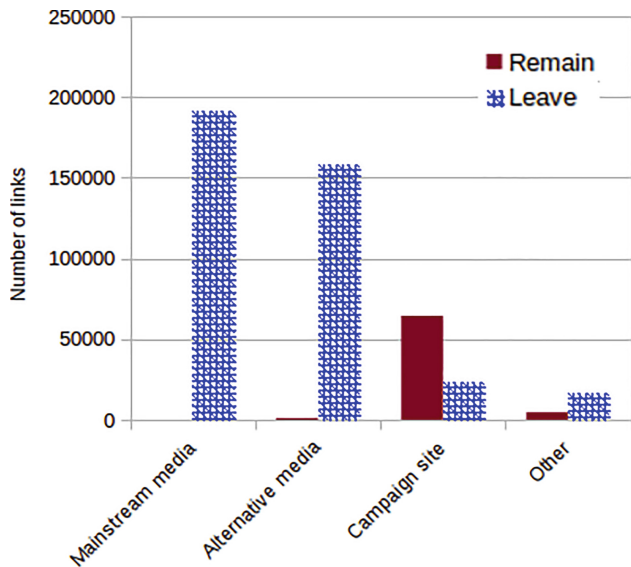


Fig. 5. Who are the PAS > 30:1 influencers?

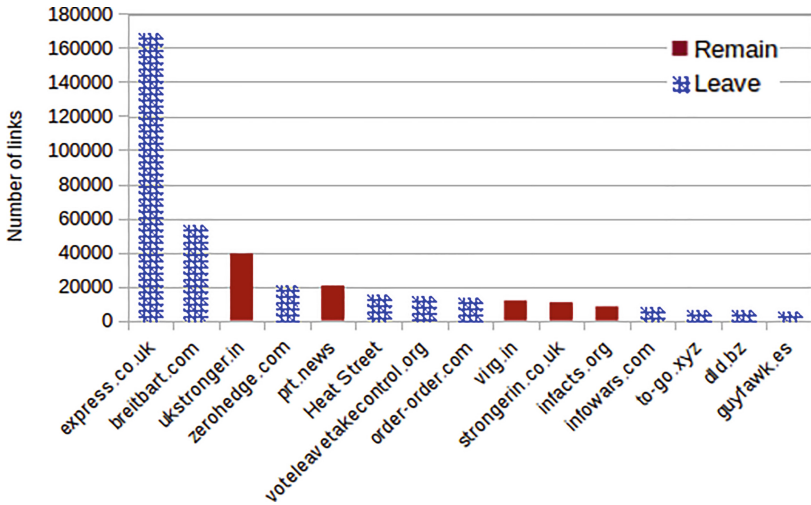


Fig. 6. Who are the PAS > 30:1 sites?

The press complaints data provides another opportunity to review uptake of partisan material. The impact of the misleading articles, at least on Twitter, seems to be relatively minor. By far the most mentioned was the claim that “the Queen backs Brexit”, receiving 2969 textual mentions, including 180 retweets of a Russian troll account, despite having run before data began to be collected, making data incomplete. The next most widely mentioned misleading headline was mentioned 199 times only. In contrast, the exonerated article “Far Right in Plot to Hijack Brexit” was the most mentioned remain headline among the press complaints, and was mentioned in text 235 times. Previous research has suggested that false rumours spread faster than true ones [21]. Claims that shaped the referendum debate offer another contrast case. Particularly prominent was leave’s claim that the EU costs the UK £350 million each week. A claim was also made by George Osborne, the then Chancellor, in favour of remain; namely that leaving the EU could cost households £4,300 per year by 2030. In our data, the remain claim appeared 9510 times in tweet text. The leave claim appeared 32755 times in text. Moore and Ramsay [15] state that the remain claim was discussed in 365 newspaper articles, whereas the leave claim was discussed in only 147. The greater media interest in the Osborne claim is unsurprising given his position of authority, but this didn’t translate into interest on Twitter. The appearance of the leave claim on the side of a bus perhaps proved compelling, appearing in photographs 900 times in our data.

*RQ3 Discussion.* Key observations from Fig. 5 include that in terms of mentions in tweets, the influence of leave sites dwarfs that of remain sites. It is also notable in that figure that high remain-PAS sites were mostly explicit campaign sites;

in other words, openly partisan, with no suggestion of providing reportage. The range of media providing high leave-PAS materials, plus the presence of Breitbart raises the question of whether these findings demonstrate a similar phenomenon happening in the UK as described by Faris *et al.*, or whether indeed it is simply the same phenomenon - an extension of the same network of propaganda.

## 7 Conclusion

Websites linked in topically related tweets during the run-up to the 2016 UK EU membership election were most often neutral or bipartisan in their appeal. However, sources with partisan appeal also captured a sizeable portion of the debate, and of those, the leave-partisan materials were much more heavily propagated. Materials with a strong appeal to leavers rather than remainers were plentiful and diverse, and included mainstream media and alternative media including US and other foreign sources. Materials with a strong appeal to remainers were fewer and less influential, and mainly comprised explicit campaign sites.

Mainstream media with a stated remain stance produced materials appealing to both sides of the debate. Some mainstream media with a stated leave stance produced materials predominantly appealing to leavers. Number of upheld press complaints shows a stronger resemblance to a site's partisan appeal than the bias of the source as determined by its number of pro-leave front pages or its stated stance, suggesting that partisan appeal is capturing something other than the extent to which a source provides a voice for a particular opinion, and that misinformation may be a part of it. However, since the sample is small, further work is required to support this. On the other hand, on the remain side, the campaign site "ukstronger.in" also showed a highly partisan appeal. One explanation for differential appeal might lie in the extent to which certain behaviours, for example the suggestion of entrenched opinion, discourage debate. Examination of the tweets shows for example that the pro-remain Guardian attracted interest in the form of critical comment, which the Express did not do to the same extent. Whilst highly partisan materials are of concern in that they may more often be misleading, and are attracting significant attention, information consumers did show a preference for linking more moderate materials, which supports the suggestion that they may be encouraging discussion to a greater extent.

Data show support for Faris *et al.*'s [4] hypothesis of network propaganda, in that a vocal anti-immigration narrative emerged, and it is possible that congruence of message accounted for the greater interest in leave materials of highly partisan appeal. However, further work would be required to support this.

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# A Most Linked Websites

See Tables 2 and 3.

**Table 2.** PAS > 3:1 Sites and Sites with Neutral Appeal

Remain PAS > 3:1	Total	Neutral	Total	Leave PAS > 3:1	Total
gov.uk	63119	twitter.com	4018371	Youtube	226382
theconversation.com	8495	The Guardian	253474	The Telegraph	148565
internacional.elpais.com	6915	BBC	242131	Daily Mail	86888
blogs.lse.ac.uk	6532	Facebook	109552	Bloomberg	53071
jkrowling.com	5975	The Independent	104572	news.sky.com	32016
economist.com	5220	amp.twimg.com	80727	The Sun	30255
eureferendum.gov.uk	4095	Reuters	71776	snpy.tv	28281
timeshighereducation.com	3738	wp.me	58287	Russia Today	23064
politics.co.uk	3344	Financial Times	44497	cnn.it	22617
politicalscrapbook.net	3266	mirror.co.uk	43467	on.wsj.com	20332
secure.avaaz.org	3159	buff.ly	40646	itv.com	17200
leftfootforward.org	3014	paper.li	39458	on.mktw.net	16838
touchstoneblog.org.uk	2655	New York Times	38441	blogs.spectator.co.uk	13298
zeit.de	2476	Huffington Post	33697	cnb.cx	12946
snp.org	2455	econ.st	29956	forbes.com	11967
tagesschau.de	2396	The Times	25519	yhoo.it	7955
cer.org.uk	2216	cards.twitter.com	21589	Sputnik	7032
greenpeace.org.uk	2078	standard.co.uk	15335	reportuk.org	6712
lavanguardia.com	2049	instagram.com	14671	International Business Times	6577
birminghammail.co.uk	1856	El Economista	13665	marketwatch.com	6090

**Table 3.** PAS > 30:1 Sites

Remain PAS > 30:1	Total	Leave PAS > 30:1	Total
ukstronger.in	39221	express.co.uk	168846
prt.news	20452	breitbart.com	55493
virg.in	11708	zerohedge.com	20531
strongerin.co.uk	10672	Heat Street	14889
infacts.org	8165	votetakecontrol.org	14235
ebx.sh	4670	order-order.com	12804
voterremain.win	2567	infowars.com	7306
unite4europe.org	1554	to-go.xyz	6107
owl.li	1462	dld.bz	5561
energydesk.greenpeace.org	1169	guyfawk.es	5072
scotlandineurope.eu	1166	specc.ie	4709
weareeurope.org.uk	1151	telegraaf.nl	4659
realnewsuk.com	1070	dailysquib.co.uk	4396
euromove.org.uk	968	davidicke.com	4184
bmj.com	900	twibble.io	4138
neweuropeans.net	788	brexitthemovie.com	3997
greenscot	741	eureferendum.com	3673
richardcorbett.org.uk	712	au.news.yahoo.com	3447
uktostay.eu	696	indiegogo.com	3369
chokkablog.blogspot.co.uk	691	live.pollstation.com	3269

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