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# Supplementary Information for characterizing the roles of bots during COVID-19 infodemic on Twitter

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## 1 CCDF

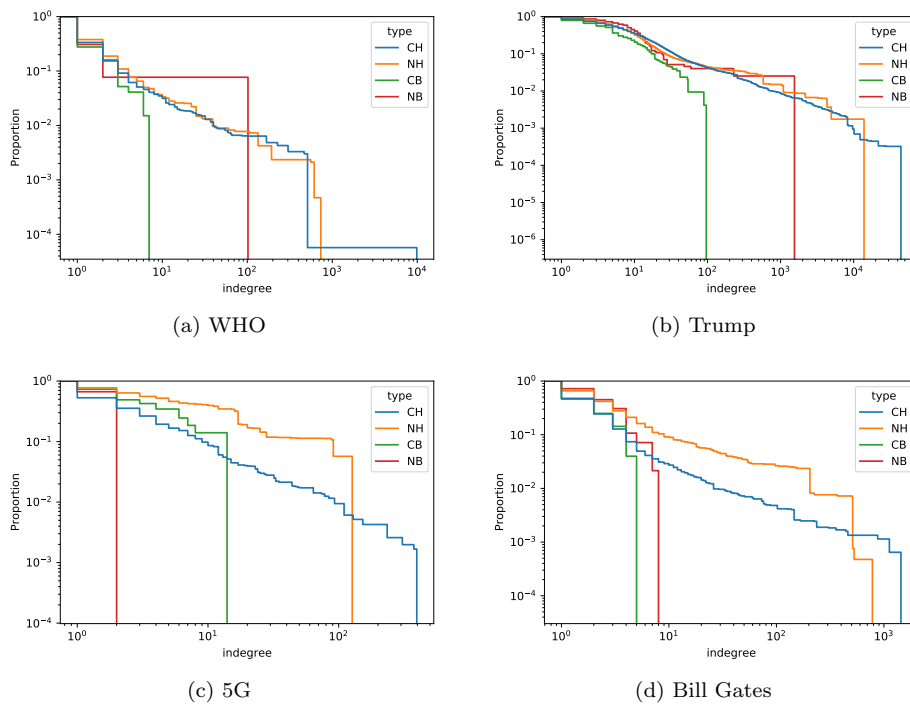


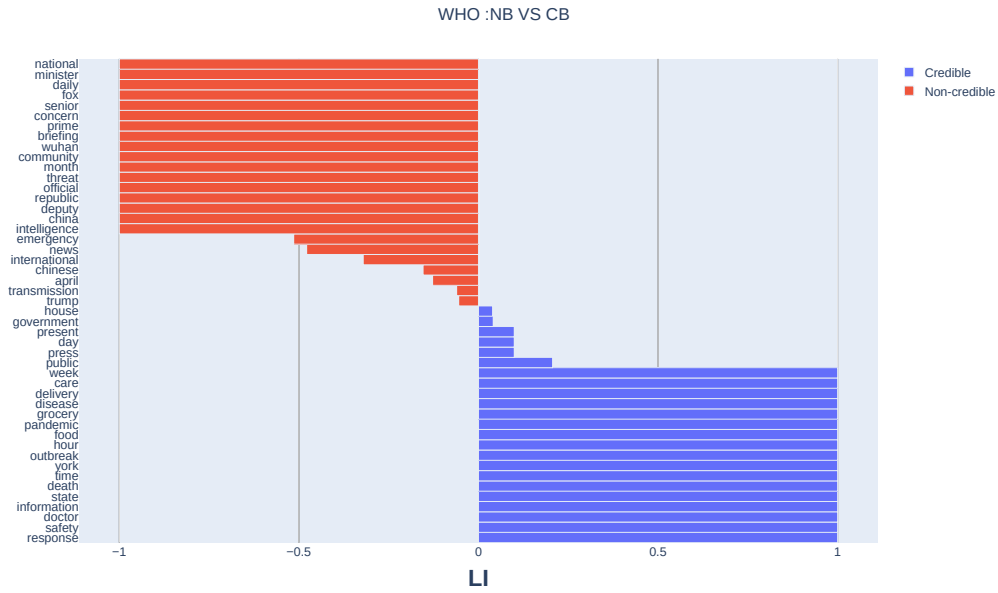
Fig. 1: CCDF curves for users of each topic.

E-mail: myrainbowandsky@gmail.com

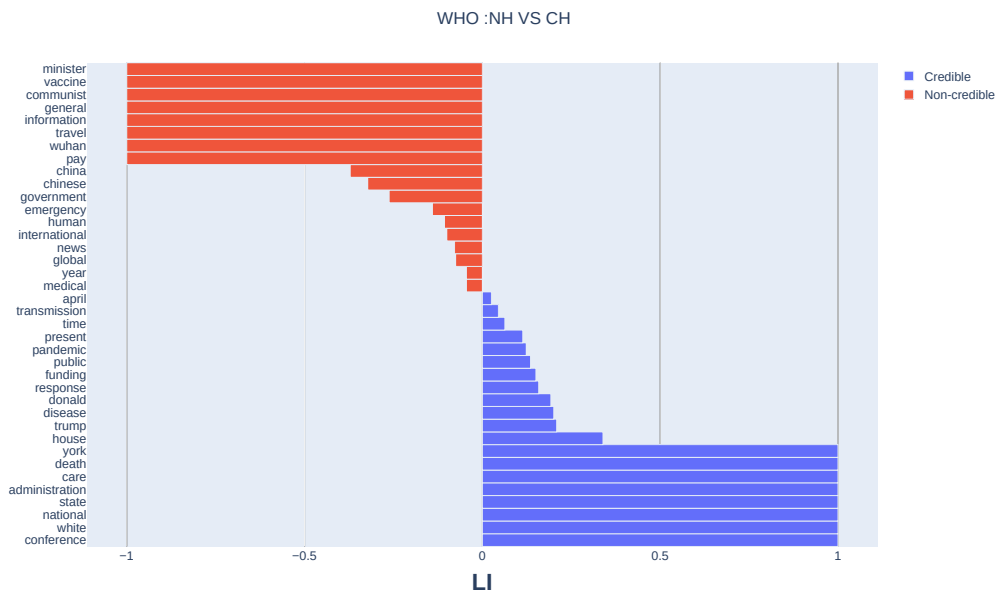
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<sup>2</sup> School of Environment and Society, Tokyo Institute of Technology, Japan

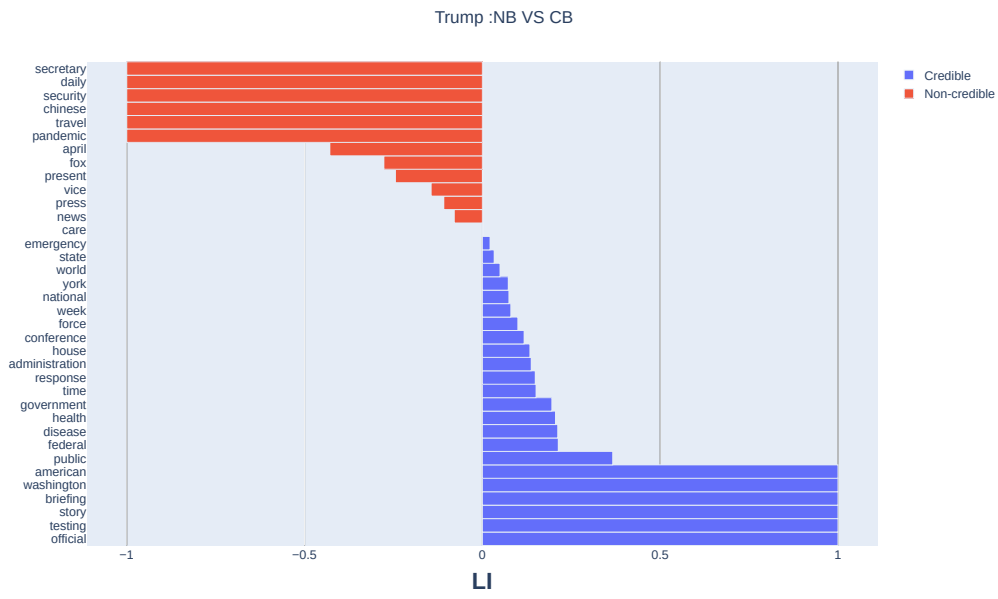
## 2 Term importance for each topic



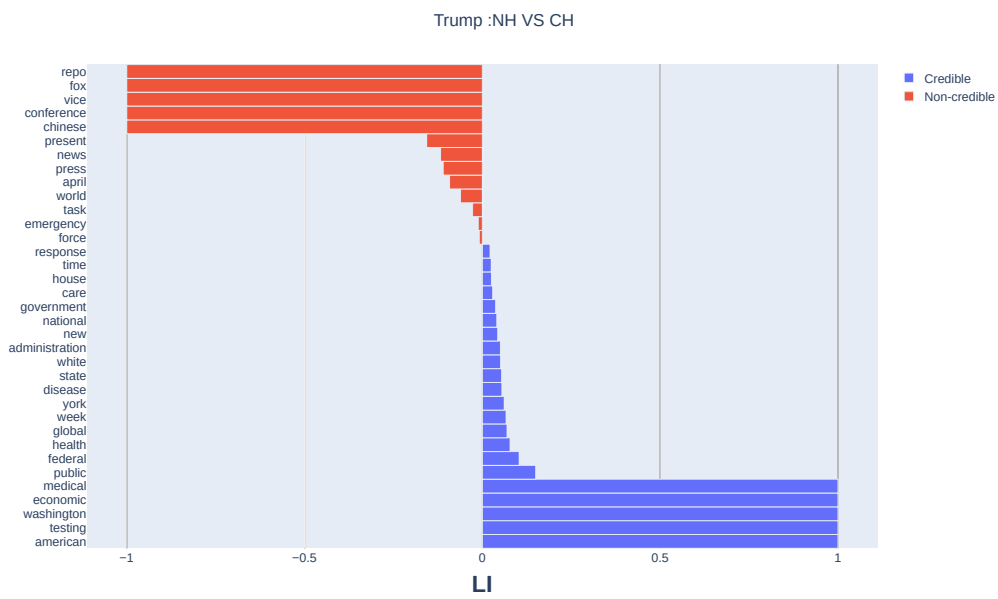
(a)



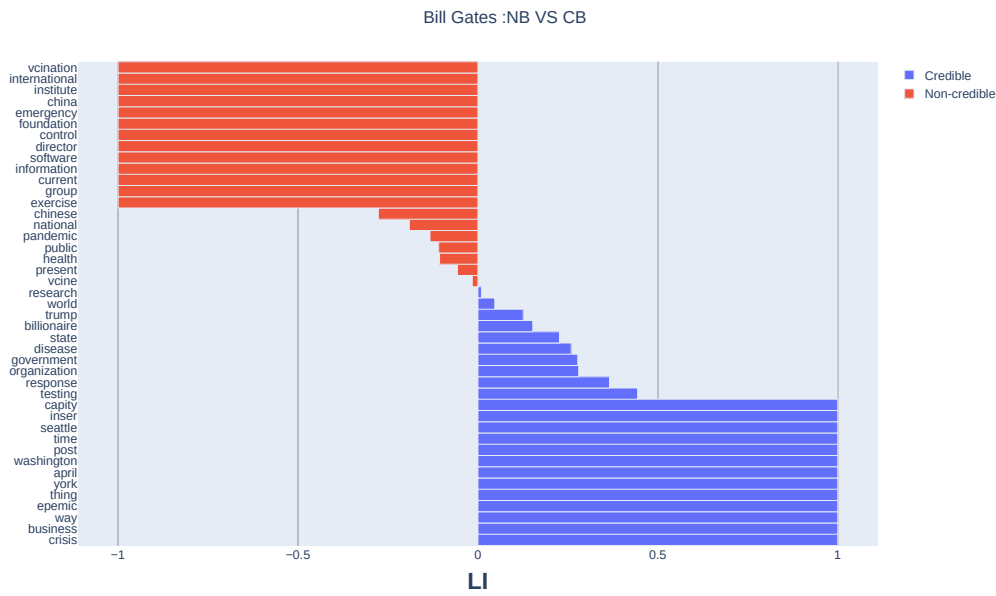
(b)



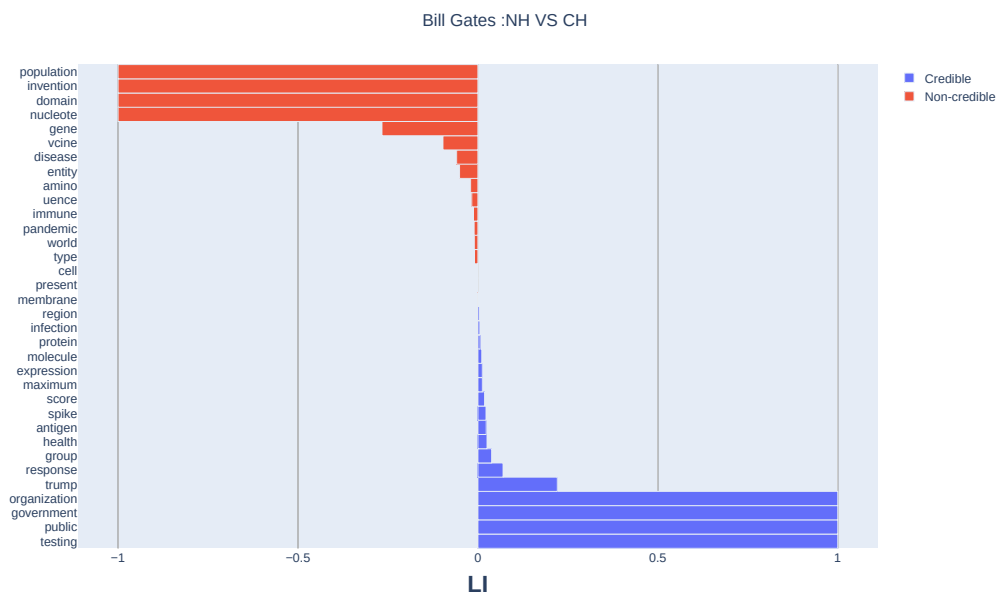
(c)



(d)



(e)



(f)

Fig. 2: Top 30 featured terms by importance ranking of credible users and non-credible users' articles of "WHO", "Trump", and "Bill Gates" topics. Red bars indicate the term was from the articles retweeted by non-credible users; while blue bars indicate the term was from the articles retweeted by credible users. (We selected the top 30 terms from credible users category and top 30 terms from non-credible users category and then merged them without duplicates.)

### 3 Retweeted domains and users

Top 10 retweeted domains and users favored by credible/non-credible humans and bots. Green for credible users; red for non-credible users; blues for others. Column labels indicate the user type who retweeted.

Table 1: WHO

(a) Top 10 domains retweeted by

	NB	CB	NH	CH
1	<a href="http://dailycaller.com">dailycaller.com</a>	<a href="http://wsj.com">wsj.com</a>	<a href="http://dailycaller.com">dailycaller.com</a>	<a href="http://wsj.com">wsj.com</a>
2	<a href="http://thegatewaypundit.com">thegatewaypundit.com</a>	<a href="http://reuters.com">reuters.com</a>	<a href="http://thegatewaypundit.com">thegatewaypundit.com</a>	<a href="http://theguardian.com">theguardian.com</a>
3	<a href="http://wikileaks.org">wikileaks.org</a>	<a href="http://theguardian.com">theguardian.com</a>	<a href="http://wikileaks.org">wikileaks.org</a>	<a href="http://cnn.com">cnn.com</a>
4	<a href="http://foxnews.com">foxnews.com</a>	<a href="http://bbc.com">bbc.com</a>	<a href="http://presstv.com">presstv.com</a>	<a href="http://washingtonpost.com">washingtonpost.com</a>
5	<a href="http://ahtribune.com">ahtribune.com</a>	<a href="http://nytimes.com">nytimes.com</a>	<a href="http://ahtribune.com">ahtribune.com</a>	<a href="http://nytimes.com">nytimes.com</a>
6	<a href="http://presstv.com">presstv.com</a>	<a href="http://bbc.co.uk">bbc.co.uk</a>	<a href="http://foxnews.com">foxnews.com</a>	<a href="http://reuters.com">reuters.com</a>
7	<a href="http://rt.com">rt.com</a>	<a href="http://cnn.com">cnn.com</a>	<a href="http://breitbart.com">breitbart.com</a>	<a href="http://bbc.com">bbc.com</a>
8	<a href="http://zerohedge.com">zerohedge.com</a>	<a href="http://usatoday.com">usatoday.com</a>	<a href="http://justthenews.com">justthenews.com</a>	<a href="http://newsweek.com">newsweek.com</a>
9	<a href="http://saraacarter.com">saraacarter.com</a>	<a href="http://washingtonpost.com">washingtonpost.com</a>	<a href="http://politicususa.com">politicususa.com</a>	<a href="http://bbc.co.uk">bbc.co.uk</a>
10	<a href="http://collective-evolution.com">collective-evolution.com</a>	<a href="http://foxnews.com">foxnews.com</a>	<a href="http://lifesitenews.com">lifesitenews.com</a>	<a href="http://justthenews.com">justthenews.com</a>

(b) Top 10 users retweeted by

	NB	CB	NH	CH
1	<a href="https://twitter.com/gatewaypundit">@gatewaypundit</a>	<a href="https://twitter.com/KimStrassel">@KimStrassel</a>	<a href="https://twitter.com/gatewaypundit">@gatewaypundit</a>	<a href="https://twitter.com/KimStrassel">@KimStrassel</a>
2	<a href="https://twitter.com/ouchinagirl">@ouchinagirl</a>	<a href="https://twitter.com/AmazonOmy">@AmazonOmy</a>	<a href="https://twitter.com/wikileaks">@wikileaks</a>	<a href="https://twitter.com/guardian">@guardian</a>
3	<a href="https://twitter.com/wikileaks">@wikileaks</a>	<a href="https://twitter.com/Vastuullisuus">@Vastuullisuus</a>	<a href="https://twitter.com/DailyCaller">@DailyCaller</a>	<a href="https://twitter.com/newtgingrich">@newtgingrich</a>
4	<a href="https://twitter.com/DailyCaller">@DailyCaller</a>	<a href="https://twitter.com/Reuters">@Reuters</a>	<a href="https://twitter.com/ouchinagirl">@ouchinagirl</a>	<a href="https://twitter.com/jsolomonReports">@jsolomonReports</a>
5	<a href="https://twitter.com/RoseGeorossi">@RoseGeorossi</a>	<a href="https://twitter.com/chidambara09">@chidambara09</a>	<a href="https://twitter.com/Ian56789">@Ian56789</a>	<a href="https://twitter.com/Newsweek">@Newsweek</a>
6	<a href="https://twitter.com/Ian56789">@Ian56789</a>	<a href="https://twitter.com/guardian">@guardian</a>	<a href="https://twitter.com/PressTV">@PressTV</a>	<a href="https://twitter.com/chidambara09">@chidambara09</a>
7	<a href="https://twitter.com/anuraag_saxena">@anuraag_saxena</a>	<a href="https://twitter.com/newtgingrich">@newtgingrich</a>	<a href="https://twitter.com/1776Stonewall">@1776Stonewall</a>	<a href="https://twitter.com/TheElders">@TheElders</a>
8	<a href="https://twitter.com/PressTV">@PressTV</a>	<a href="https://twitter.com/jsolomonReports">@jsolomonReports</a>	<a href="https://twitter.com/anuraag_saxena">@anuraag_saxena</a>	<a href="https://twitter.com/Reuters">@Reuters</a>
9	<a href="https://twitter.com/Doodisgirl">@Doodisgirl</a>	<a href="https://twitter.com/ABC">@ABC</a>	<a href="https://twitter.com/jsolomonReports">@jsolomonReports</a>	<a href="https://twitter.com/mitchellvii">@mitchellvii</a>
10	<a href="https://twitter.com/RT.com">@RT.com</a>	<a href="https://twitter.com/verge">@verge</a>	<a href="https://twitter.com/Doodisgirl">@Doodisgirl</a>	<a href="https://twitter.com/RWPUSA">@RWPUSA</a>

Table 2: Trump

(a) Top 10 domains retweeted by

	NB	CB	NH	CH
1	<a href="https://www.foxnews.com">foxnews.com</a>	<a href="https://www.nytimes.com">nytimes.com</a>	<a href="https://www.dailycaller.com">dailycaller.com</a>	<a href="https://www.nytimes.com">nytimes.com</a>
2	<a href="https://www.dailycaller.com">dailycaller.com</a>	<a href="https://www.cnn.com">cnn.com</a>	<a href="https://www.foxnews.com">foxnews.com</a>	<a href="https://www.washingtonpost.com">washingtonpost.com</a>
3	<a href="https://www.breitbart.com">breitbart.com</a>	<a href="https://www.theguardian.com">theguardian.com</a>	<a href="https://www.breitbart.com">breitbart.com</a>	<a href="https://www.theguardian.com">theguardian.com</a>
4	<a href="https://www.dailywire.com">dailywire.com</a>	<a href="https://www.washingtonpost.com">washingtonpost.com</a>	<a href="https://www.justthenews.com">justthenews.com</a>	<a href="https://www.cnn.com">cnn.com</a>
5	<a href="https://www.nypost.com">nypost.com</a>	<a href="https://www.yahoo.com">yahoo.com</a>	<a href="https://www.dailywire.com">dailywire.com</a>	<a href="https://www.rawstory.com">rawstory.com</a>
6	<a href="https://www.justthenews.com">justthenews.com</a>	<a href="https://www.thehill.com">thehill.com</a>	<a href="https://www.thegatewaypundit.com">thegatewaypundit.com</a>	<a href="https://www.thehill.com">thehill.com</a>
7	<a href="https://www.thegatewaypundit.com">thegatewaypundit.com</a>	<a href="https://www.reuters.com">reuters.com</a>	<a href="https://www.hannity.com">hannity.com</a>	<a href="https://www.vox.com">vox.com</a>
8	<a href="https://www.coronavirus.gov">CoronaVirus.gov</a>	<a href="https://www.vox.com">vox.com</a>	<a href="https://www.politicususa.com">politicususa.com</a>	<a href="https://www.politico.com">politico.com</a>
9	<a href="https://www.politicususa.com">politicususa.com</a>	<a href="https://www.politico.com">politico.com</a>	<a href="https://www.nypost.com">nypost.com</a>	<a href="https://www.independent.co.uk">independent.co.uk</a>
10	<a href="https://www.hannity.com">hannity.com</a>	<a href="https://www.cbsnews.com">cbsnews.com</a>	<a href="https://www.coronavirus.gov">CoronaVirus.gov</a>	<a href="https://www.yahoo.com">yahoo.com</a>

(b) Top 10 users retweeted by

	NB	CB	NH	CH
1	<a href="https://twitter.com/DailyCaller">@DailyCaller</a>	<a href="https://twitter.com/washingtonpost">@washingtonpost</a>	<a href="https://twitter.com/DailyCaller">@DailyCaller</a>	<a href="https://twitter.com/washingtonpost">@washingtonpost</a>
2	<a href="https://twitter.com/DonaldJTrumpJr">@DonaldJTrumpJr</a>	<a href="https://twitter.com/thehill">@thehill</a>	<a href="https://twitter.com/DonaldJTrumpJr">@DonaldJTrumpJr</a>	<a href="https://twitter.com/thehill">@thehill</a>
3	<a href="https://twitter.com/TrumpWarRoom">@TrumpWarRoom</a>	<a href="https://twitter.com/CBSNews">@CBSNews</a>	<a href="https://twitter.com/jsolomonReports">@jsolomonReports</a>	<a href="https://twitter.com/HillaryClinton">@HillaryClinton</a>
4	<a href="https://twitter.com/yogagenie">@yogagenie</a>	<a href="https://twitter.com/guardian">@guardian</a>	<a href="https://twitter.com/seanhannity">@seanhannity</a>	<a href="https://twitter.com/TeaPainUSA">@TeaPainUSA</a>
5	<a href="https://twitter.com/realDonaldTrump">@realDonaldTrump</a>	<a href="https://twitter.com/realDonaldTrump">@realDonaldTrump</a>	<a href="https://twitter.com/TrumpWarRoom">@TrumpWarRoom</a>	<a href="https://twitter.com/guardian">@guardian</a>
6	<a href="https://twitter.com/Rparkerscience">@Rparkerscience</a>	<a href="https://twitter.com/HillaryClinton">@HillaryClinton</a>	<a href="https://twitter.com/marklevinshow">@marklevinshow</a>	<a href="https://twitter.com/JoeBiden">@JoeBiden</a>
7	<a href="https://twitter.com/seanhannity">@seanhannity</a>	<a href="https://twitter.com/Independent">@Independent</a>	<a href="https://twitter.com/realDonaldTrump">@realDonaldTrump</a>	<a href="https://twitter.com/BillKristol">@BillKristol</a>
8	<a href="https://twitter.com/jsolomonReports">@jsolomonReports</a>	<a href="https://twitter.com/voxdotcom">@voxdotcom</a>	<a href="https://twitter.com/RealJamesWoods">@RealJamesWoods</a>	<a href="https://twitter.com/Independent">@Independent</a>
9	<a href="https://twitter.com/Bamafanaticfan1">@Bamafanaticfan1</a>	<a href="https://twitter.com/CNNPolitics">@CNNPolitics</a>	<a href="https://twitter.com/thehill">@thehill</a>	<a href="https://twitter.com/CNNPolitics">@CNNPolitics</a>
10	<a href="https://twitter.com/thehill">@thehill</a>	<a href="https://twitter.com/Thomas1774Paine">@Thomas1774Paine</a>	<a href="https://twitter.com/Thomas1774Paine">@Thomas1774Paine</a>	<a href="https://twitter.com/realDonaldTrump">@realDonaldTrump</a>

Table 3: 5G

(a) Top 10 domains retweeted by

	NB	CB	NH	CH
1	<a href="http://beforeitsnews.com">beforeitsnews.com</a>	<a href="http://bbc.co.uk">bbc.co.uk</a>	<a href="http://worldtruth.tv">worldtruth.tv</a>	<a href="http://theguardian.com">theguardian.com</a>
2	<a href="http://dailypost.ng">dailypost.ng</a>	<a href="http://theguardian.com">theguardian.com</a>	<a href="http://express.co.uk">express.co.uk</a>	<a href="http://bbc.co.uk">bbc.co.uk</a>
3	<a href="http://worldtruth.tv">worldtruth.tv</a>	<a href="http://bbc.com">bbc.com</a>	<a href="http://infowars.com">infowars.com</a>	<a href="http://bbc.com">bbc.com</a>
4	<a href="http://zerohedge.com">zerohedge.com</a>	<a href="http://reuters.com">reuters.com</a>	<a href="http://beforeitsnews.com">beforeitsnews.com</a>	<a href="http://theverge.com">theverge.com</a>
5	<a href="http://dailyrecord.co.uk">dailyrecord.co.uk</a>	<a href="http://theverge.com">theverge.com</a>	<a href="http://humansarefree.com">humansarefree.com</a>	<a href="http://businessinsider.com">businessinsider.com</a>
6	<a href="http://today.ng">today.ng</a>	<a href="http://cnn.com">cnn.com</a>	<a href="http://neonnettle.com">neonnettle.com</a>	<a href="http://cnn.com">cnn.com</a>
7	<a href="http://infowars.com">infowars.com</a>	<a href="http://businessinsider.com">businessinsider.com</a>	<a href="http://thelastamericanvagabond.com">thelastamericanvagabond.com</a>	<a href="http://reuters.com">reuters.com</a>
8	<a href="http://banned.video">banned.video</a>	<a href="http://nytimes.com">nytimes.com</a>	<a href="http://dailycaller.com">dailycaller.com</a>	<a href="http://ft.com">ft.com</a>
9	<a href="http://thetruthaboutcancer.com">thetruthaboutcancer.com</a>	<a href="http://newsweek.com">newsweek.com</a>	<a href="http://paulcraigroberts.org">paulcraigroberts.org</a>	<a href="http://vox.com">vox.com</a>
10	<a href="http://rt.com">rt.com</a>	<a href="http://vox.com">vox.com</a>	<a href="http://thesun.co.uk">thesun.co.uk</a>	<a href="http://nytimes.com">nytimes.com</a>

(b) Top 10 users retweeted by

	NB	CB	NH	CH
1	<a href="https://twitter.com/shinethelight17">@shinethelight17</a>	<a href="https://twitter.com/Reuters">@Reuters</a>	<a href="https://twitter.com/WorldTruthTV">@WorldTruthTV</a>	<a href="https://twitter.com/guardian">@guardian</a>
2	<a href="https://twitter.com/DailyPostNGR">@DailyPostNGR</a>	<a href="https://twitter.com/guidaautonoma">@guidaautonoma</a>	<a href="https://twitter.com/BILDERBERG_GP">@BILDERBERG_GP</a>	<a href="https://twitter.com/rooshv">@rooshv</a>
3	<a href="https://twitter.com/Laurel700">@Laurel700</a>	<a href="https://twitter.com/Exchange5g">@Exchange5g</a>	<a href="https://twitter.com/davidicke">@davidicke</a>	<a href="https://twitter.com/guardiannews">@guardiannews</a>
4	<a href="https://twitter.com/davidicke">@davidicke</a>	<a href="https://twitter.com/rooshv">@rooshv</a>	<a href="https://twitter.com/shinethelight17">@shinethelight17</a>	<a href="https://twitter.com/verge">@verge</a>
5	<a href="https://twitter.com/freezerohedge">@freezerohedge</a>	<a href="https://twitter.com/HaroldSinnott">@HaroldSinnott</a>	<a href="https://twitter.com/TornadoNewsLink">@TornadoNewsLink</a>	<a href="https://twitter.com/Omojuwa">@Omojuwa</a>
6	<a href="https://twitter.com/NigeriaNewsdesk">@NigeriaNewsdesk</a>	<a href="https://twitter.com/verge">@verge</a>	<a href="https://twitter.com/boblister_poole">@boblister_poole</a>	<a href="https://twitter.com/Reuters">@Reuters</a>
7	<a href="https://twitter.com/BANNEDdotVIDEO">@BANNEDdotVIDEO</a>	<a href="https://twitter.com/ipfconline1">@ipfconline1</a>	<a href="https://twitter.com/DailyPostNGR">@DailyPostNGR</a>	<a href="https://twitter.com/davidicke">@davidicke</a>
8	<a href="https://twitter.com/WorldTruthTV">@WorldTruthTV</a>	<a href="https://twitter.com/Shirastweet">@Shirastweet</a>	<a href="https://twitter.com/BANNEDdotVIDEO">@BANNEDdotVIDEO</a>	<a href="https://twitter.com/Exchange5g">@Exchange5g</a>
9	<a href="https://twitter.com/owhy3">@owhy3</a>	<a href="https://twitter.com/nuskitconsultan">@nuskitconsultan</a>	<a href="https://twitter.com/davidkurten">@davidkurten</a>	<a href="https://twitter.com/davidkurten">@davidkurten</a>
10		<a href="https://twitter.com/guardian">@guardian</a>	<a href="https://twitter.com/buttscornershop">@buttscornershop</a>	<a href="https://twitter.com/ruskin147">@ruskin147</a>

Table 4: Bill Gates

(a) Top 10 domains retweeted by

	NB	CB	NH	CH
1	<a href="http://thegatewaypundit.com">thegatewaypundit.com</a>	<a href="http://thehill.com">thehill.com</a>	<a href="http://thegatewaypundit.com">thegatewaypundit.com</a>	<a href="http://thehill.com">thehill.com</a>
2	<a href="http://dailycaller.com">dailycaller.com</a>	<a href="http://nytimes.com">nytimes.com</a>	<a href="http://activistpost.com">activistpost.com</a>	<a href="http://nytimes.com">nytimes.com</a>
3	<a href="http://newspunch.com">newspunch.com</a>	<a href="http://vox.com">vox.com</a>	<a href="http://express.co.uk">express.co.uk</a>	<a href="http://washingtonpost.com">washingtonpost.com</a>
4	<a href="http://nypost.com">nypost.com</a>	<a href="http://washingtonpost.com">washingtonpost.com</a>	<a href="http://dailycaller.com">dailycaller.com</a>	<a href="http://businessinsider.com">businessinsider.com</a>
5	<a href="http://bloomberg.com">bloomberg.com</a>	<a href="http://businessinsider.com">businessinsider.com</a>	<a href="http://newspunch.com">newspunch.com</a>	<a href="http://vox.com">vox.com</a>
6	<a href="http://express.co.uk">express.co.uk</a>	<a href="http://wsj.com">wsj.com</a>	<a href="http://nypost.com">nypost.com</a>	<a href="http://theverge.com">theverge.com</a>
7	<a href="http://americanthinker.com">americanthinker.com</a>	<a href="http://cnn.com">cnn.com</a>	<a href="http://worldtruth.tv">worldtruth.tv</a>	<a href="http://wsj.com">wsj.com</a>
8	<a href="http://activistpost.com">activistpost.com</a>	<a href="http://theverge.com">theverge.com</a>	<a href="http://zerohedge.com">zerohedge.com</a>	<a href="http://newspunch.com">newspunch.com</a>
9	<a href="http://presstv.com">presstv.com</a>	<a href="http://bbc.co.uk">bbc.co.uk</a>	<a href="http://montanadailygazette.com">montanadailygazette.com</a>	<a href="http://cnn.com">cnn.com</a>
10	<a href="http://naturalblaze.com">naturalblaze.com</a>	<a href="http://reuters.com">reuters.com</a>	<a href="http://blacklistednews.com">blacklistednews.com</a>	<a href="http://thedailybeast.com">thedailybeast.com</a>

(b) Top 10 users retweeted by

	NB	CB	NH	CH
1	<a href="https://twitter.com/EyesOnQ">@EyesOnQ</a>	<a href="https://twitter.com/cjtruth">@cjtruth</a>	<a href="https://twitter.com/o_rips">@o_rips</a>	<a href="https://twitter.com/cjtruth">@cjtruth</a>
2	<a href="https://twitter.com/Ian56789">@Ian56789</a>	<a href="https://twitter.com/EyesOnQ">@EyesOnQ</a>	<a href="https://twitter.com/gatewaypundit">@gatewaypundit</a>	<a href="https://twitter.com/EyesOnQ">@EyesOnQ</a>
3	<a href="https://twitter.com/zsixkiller">@zsixkiller</a>	<a href="https://twitter.com/joshrogin">@joshrogin</a>	<a href="https://twitter.com/EyesOnQ">@EyesOnQ</a>	<a href="https://twitter.com/carminabrendel">@carminabrendel</a>
4	<a href="https://twitter.com/gatewaypundit">@gatewaypundit</a>	<a href="https://twitter.com/WSJ">@WSJ</a>	<a href="https://twitter.com/bbusa617">@bbusa617</a>	<a href="https://twitter.com/joshrogin">@joshrogin</a>
5	<a href="https://twitter.com/gaye_gallops">@gaye_gallops</a>	<a href="https://twitter.com/sapinker">@sapinker</a>	<a href="https://twitter.com/Ian56789">@Ian56789</a>	<a href="https://twitter.com/WSJ">@WSJ</a>
6	<a href="https://twitter.com/taxfreeok">@taxfreeok</a>	<a href="https://twitter.com/HollyWilhelm4">@HollyWilhelm4</a>	<a href="https://twitter.com/KarluskaP">@KarluskaP</a>	<a href="https://twitter.com/HollyWilhelm4">@HollyWilhelm4</a>
7	<a href="https://twitter.com/SM0799">@SM0799</a>	<a href="https://twitter.com/businessinsider">@businessinsider</a>	<a href="https://twitter.com/DailyCaller">@DailyCaller</a>	<a href="https://twitter.com/sapinker">@sapinker</a>
8	<a href="https://twitter.com/bbusa617">@bbusa617</a>	<a href="https://twitter.com/carminabrendel">@carminabrendel</a>	<a href="https://twitter.com/davidicke">@davidicke</a>	<a href="https://twitter.com/ezraklein">@ezraklein</a>
9	<a href="https://twitter.com/DailyCaller">@DailyCaller</a>	<a href="https://twitter.com/voxdotcom">@voxdotcom</a>	<a href="https://twitter.com/WorldTruthTV">@WorldTruthTV</a>	<a href="https://twitter.com/stanveuger">@stanveuger</a>
10	<a href="https://twitter.com/davidicke">@davidicke</a>	<a href="https://twitter.com/gaye_gallops">@gaye_gallops</a>	<a href="https://twitter.com/zsixkiller">@zsixkiller</a>	<a href="https://twitter.com/thehill">@thehill</a>