JoCTEC Journal of Communication Technology

Published by the Communication Technology Division
of the Association for Education in Journalism and Mass Communication

Social Construction of Blockchain on Social Media: Framing Public Discourses on Twitter

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Peer review: This article has been subject to a double-blind peer review process

Abstract

Blockchain has become a hot topic in technology, finance, regulation, and the wider society in recent years. Along the way, various users and interests have shaped the technology materially and discursively. This paper investigates the debate taking place on Twitter surrounding blockchain technology to understand the nature and development of its online public discourses. We collected and analyzed a Twitter dataset containing a total of 267,512 tweets that reference blockchain by 105,734 unique users. We conducted a mixed method research study involving qualitative and quantitative approaches. The results indicate that the majority of the retweeted posts are educational and promotional in nature, while the lowest numbers of frames are critical or sceptical of the new technology. The most active users seem to be largely involved in promoting the technology including some that are human created bots. The paper employs the theory of Social Construction of Technology (SCOT) that emphasizes the way our actions and discourses shape technology. We argue that a number of active Twitter users, for a variety of motives including financial ones, are shaping the discourse about blockchain by mostly framing it as a positive development in the global market, allegedly creating a revolution in the financial sector. More importantly, the social construction of technology on Twitter does not seem to be exclusively organic, for it includes bots and online spammers who mostly tweet promotional blockchain hashtags.

Keywords: blockchain, Bitcoin, social construction of technology, social media, public discourse

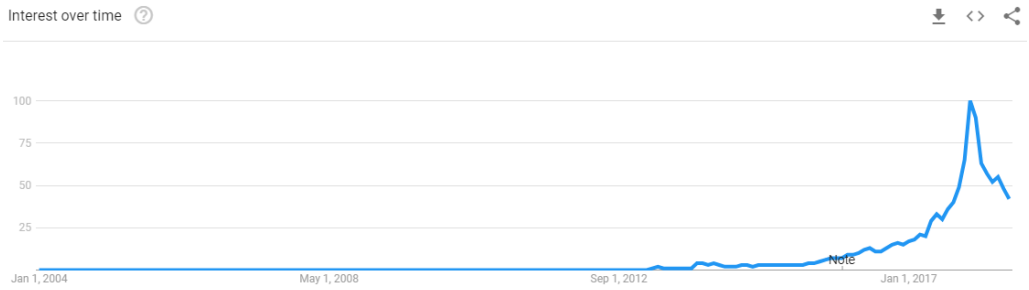
Introduction

Blockchain has garnered a lot of attention as a potentially disruptive technology that could have wide-reaching implications. Its impact has been felt across many sectors, such as technology, finance, and healthcare, as well as people's everyday lives. Blockchain is a decentralized, digital ledger that allows users to store pieces of information on multiple computers all over the world. It enables peer-to-peer value transfers of many kinds, such as digital currencies and physical commodities, without the need for traditional intermediaries such as payment companies, banks, or lawyers. The first blockchain application, Bitcoin, has grown from a hobby among computer programmers and curiosity to a global mechanism for value transaction and a digital currency. Most recently, 'hodl'ers' (long term holders) use it as a store of value and refer to it as digital gold. Many other types of blockchains and applications have been developed by entrepreneurs, enthusiasts, and various communities since Bitcoin's creation. Communication and Science, Technology and Society (STS) scholars argue that along the way various users and interests shape a technology materially and discursively. We are curious about the latter dynamic, the discursive moves of actors in the case of blockchain.

We investigate public debate taking place on Twitter as a way to understand how actors are constructing and shaping new meanings about blockchain technology (Bijker, Bal, & Hendriks, 2009; Bijker, Hughes, & Pinch, 2012). The social media platform Twitter is a key place where the public is animatedly and proactively debating about the current state and the possible future of blockchain and Distributed Ledger Technologies (DLT) more in general (Chow-White, Lusoli, Phan, & Green, 2020). The technology is a global distributed ledger database recording all the transactions taking place within a network (Chow-White et al., 2020; Frizzo-Barker et al., 2019; Swan, 2015; Tapscott & Tapscott, 2017; Yli-Huumo, Ko, Choi, Park, & Smolander, 2016). Most blockchains (lowercased, used throughout this paper as a common noun not referring to a specific application) are decentralised databases with no central authority that are maintained by a distributed network of community members, and all transactions are recorded into discrete blocks and linked together in a chain (Umeh, 2016; Underwood, 2016). The discourse surrounding blockchain is varied and emerging (Swartz, 2017; Wang & Vergne, 2017). Many developers and enthusiasts claim blockchain will revolutionize monetary systems and create a better Internet and fairer society (Adams et al., 2019; Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). On the other hand, skeptics argue blockchain's future is uncertain, and its major applications, like Bitcoin, will fail spectacularly.

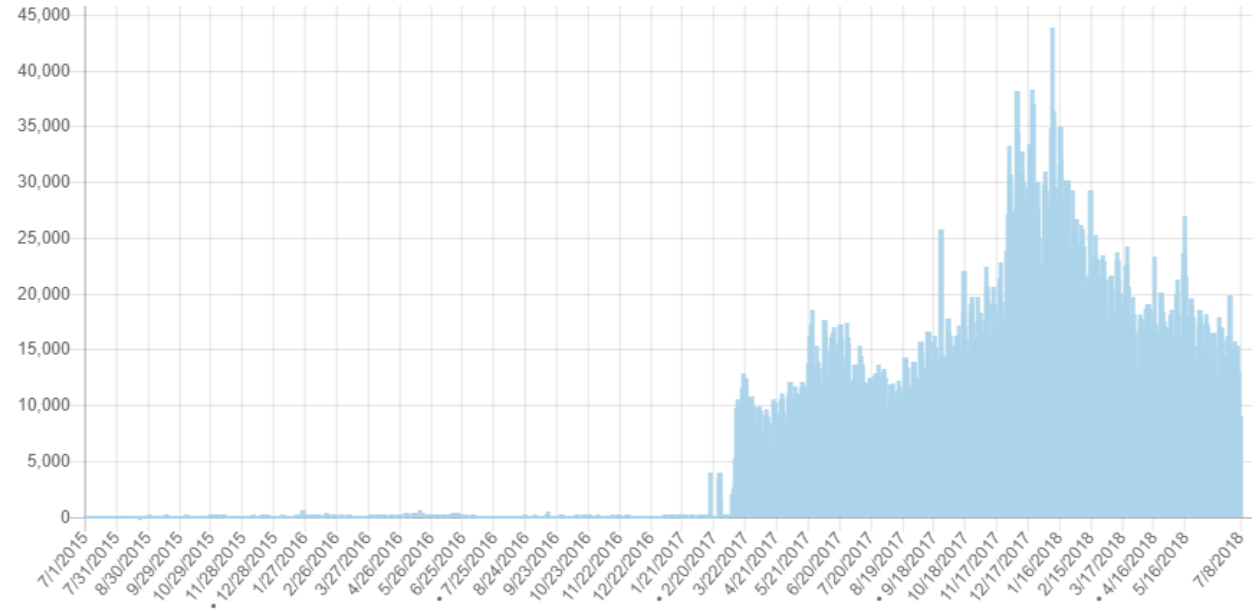
Though blockchain technology has turned ten in 2019, it only started recently getting references in mainstream public discourse especially in relation to applications like Bitcoin and Ethereum (Herian, 2018). The media began following this technology with increased attention in 2011 when blockchain and its most famous application, Bitcoin, started appearing increasingly often on the front pages of prominent journals and magazines (Bheemaiah, 2015; Kosner, 2014; O'Leary, 2012, De Filippi, 2013; Leon Zhao, Fan, & Yan, 2017). A search on Google worldwide Trends and Wikipedia shows that the search for blockchain peaked on Google in December 2017 and Wikipedia searches reached their peak in January 2018 (See Figure 1 & 2). Our study shows a similar trend as the 267,512 tweets we collected mostly peaked in late 2017 (Figure 3).

Figure 1. Google searches of "Blockchain" from January 2004 to July 2018*.



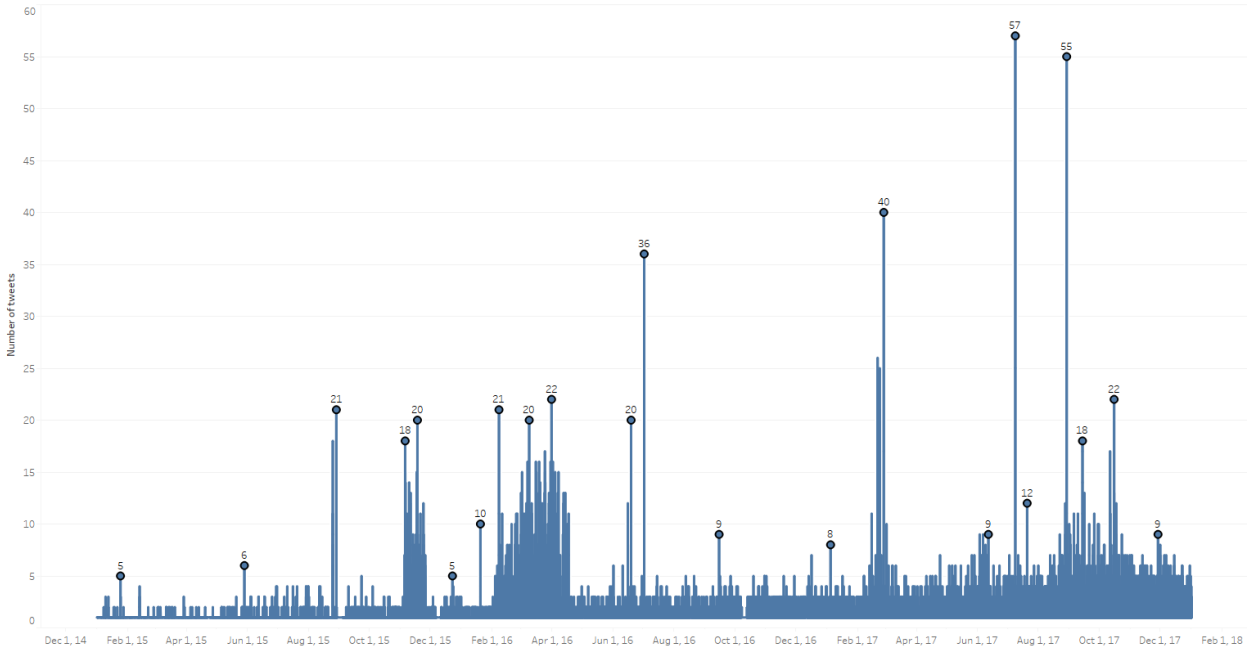
*Google searches peaked in December 2017 (score: 100) followed by January 2018 (score: 89)

Figure 2. Wikipedia searches for "Blockchain" from July 2015 to July 2018*.



*The Blockchain English Wikipedia page had 7,694,653 pageviews and was ranked 415 of the most viewed pages as of June 2018.

Figure 3. Blockchain tweets frequency from 1 January 2015 to 31 December 2017.



In the early days of Bitcoin, discussions about cryptocurrencies took place mostly on web forums and sites such as Reddit, Bitcoin Talk, Twitter, and emerging industry media such as Bitcoin Magazine, CoinDesk, and Coin Telegraph (Karlstrøm, 2014). Bitcoin's popularity grew rapidly starting in 2011, when the media started following the development of cryptocurrencies with closer attention (De Filippi, 2013). The hype generated by the press was boosted by scandals that involved the use of cryptocurrencies. Examples include the infamous Silk Road case, an online marketplace for trading, amongst other things, illicit drugs (De Filippi & Loveluck, 2016). On that occasion, Wired magazine stigmatized Bitcoin as "the online equivalent of a brown paper bag of cash" (Chen, 2011, pg. 13). The same sentiment applies when hackers attacked the then-largest bitcoin exchange platform, Mt.Gox, and allegedly stole 850,000 Bitcoins in June 2011. Questions about Bitcoin's reliability and security did not take long to start surfacing in the media (Ludwig, 2011; O'Leary, 2012). The hype surrounding Bitcoin culminated on December 17 2017, when the cryptocurrency price peaked at $19,086,64. The discourse has recently shifted towards Bitcoin being a potential safe harbor like gold during 2019 and, especially, the Covid-19 global pandemic and financial collapse (Conlon & McGee, 2020).

Most importantly, the discussion about blockchain technologies is not limited to online magazines and newspapers alone. Social media are also spaces where the public participates in discussions about specific topics or events (Small, 2011). Communication scholars have described social media as "communicative spaces" fostering the development of public discourses about new and emerging

technologies (Chow-White et al., 2018; Marres, 2015; Marres & Moats, 2015). In the case of blockchain, the social media platform Twitter is a place where the public is animatedly debating about the current state and the possible futures of distributed ledger technologies. The platform's textual affordances, the possibility to engage in structured conversations via replies and retweets, and the availability of solid API for data retrieval make of Twitter a suitable space for observing and analyzing the unfolding of the blockchain discourse compared, for example, to more visual platforms such as TikTok and Instagram. We chose Twitter also because of its popularity among many communities that discuss blockchain technologies. Our research goals are two-fold: 1) Explore Twitter to understand which frames of meaning are employed to make sense of blockchain and 2) Understand who is animating online debates about blockchain.

Literature Review

Blockchain as A Socially Constructed Technology

We employ a social constructivist understanding of technology to describe blockchain as an artifact that is interpretatively flexible and open to multiple interpretations and uses (Bijker, Hughes, & Pinch, 2012). Constructivism emerged in the early 1980s as a school of thought within the larger field of Science and Technology Studies (STS). It marked a social turn in the study of technological systems. Constructivism questions the instrumentalist and substantivist theories of technology which essentialize either the impact of human factors or technical features in defining the nature of technology. The instrumentalist theory conceptualizes technology as rational and neutral tools that are universally applicable to various contexts and the use of which are solely determined by human agency (Feenberg, 2002; Verbeek, 2005). The substantivist theory, on the other hand, emphasizes the deterministic qualities of technology in shaping and ultimately controlling a society (Ellul, 1964; Winner, 1978). Rather than defying the role of either human agency or technical features, social constructivism positions itself outside the instrumentalist and substantivist debate. As a theoretical framework, social constructivism breaks with deterministic conceptions of progress which describe technological advancements driven exclusively by technical factors such as efficiency or effectiveness. It proposes an alternative formulation where both human and technical factors are mutually interdependent in shaping a specific artifact's technological development. Doing so, constructivisms conceives "technology as a dimension of society rather than as an external force acting on it" (Feenberg, 1999, p. 10). Pinch, Bijker and Hughes, in their landmark essay on the social construction of the bicycle (1984), argued that the meanings attributed to an artifact by members of a social group

play a crucial role in its technological development . At the early stage of technology's development or what is known as the stage of interpretative flexibility, the interactions between groups usually involve diverging, if not conflicting interpretations. Controversies are eventually resolved when a particular interpretation gains dominance and actors reach rhetorical closure through some form of consensus (Feenberg, 1999, p.12). Consensus can either be a formal agreement or in the form of a cultural common sense or institutionalization over time. At this point, the socially constructed dimension of technology fades into the background and is black-boxed while its stabilized meaning enters the public discourse and remains largely beyond the point of questioning and interrogations. The exception includes the cases when the public and other social groups intervene to rearticulate and redesign the technology according to more diverse perspectives (Feenberg, 2017). For example, the automobile has been the site of design contestation a number of times over a century (Kline & Pinch, 1996). Interest groups have intervened to make it safer and, later in the 20th and 21st centuries, more environmentally responsible.

Central to the constructivist analysis of technological development is the concept of symmetry. This concept was first introduced by Pinch and Bijker (1984). They draw on the empirical program of relativism in the sociology of scientific knowledge (Bloor, 1981) to argue that for every established technology there are always alternatives that might have been developed in the place of the successful one. The first symmetry principle was later supplemented by a second conception of symmetry: the one between humans and non-humans actants. This was introduced by Bruno Latour as part of his actor-network theory (Latour, 1996; Latour and Woolgar, 1986). It argues that in the analysis of technological controversies, technical, and social aspects should be considered as equally important (Callon, 1986). In particular, the second symmetry promoted a post-humanist conception of technological development and argued non-human actors (e.g. artifacts and natural elements) can be endowed with agency and become active participants in technological controversies just like humans. Each attempt by actors, either human or non-human, to articulate the controversy in their favor necessarily changes the controversy and creates new versions of the things at stake (Marres & Moats, 2015, p. 3). Scholars should, therefore, treat social factors just as relevant as technical and natural ones in influencing the evolution of technological artifacts.

We follow the constructivist position and argue the meaning of blockchain is not immanent in the technology itself and its applications are all but determined by technical factors alone (Feenberg, 1992). As a technology in its early stage of development,

blockchain is still far from reaching rhetorical closure and holds various contingent meanings that are widely debated by different actors. The media, investors, banks, governments, private companies, marketers, spam-bots, and the 'public' more in general, can still interpret the same technological artifact differently and, consequently, assign different sets of meaning, beliefs, and values, to blockchain (Latour, 1987; Lane & Maxfield, 2005). As communication scholars, we are interested in understanding what this process of meaning creation and stabilization looks like during this time period and what discursive frames and rhetorical moves characterize actors talk about the unfolding technology blockchain (Green, 2004; Green, Li, & Nohria, 2009).

Studying Technological Controversies on Social Media: The Third Symmetry

The diffusion of social media platforms is making it easier for scholars to observe and study who, and how, participates in this process of meaning construction and circulation (Bruns & Burgess, 2012; Jacobson & Mascaro, 2016). Social media are, therefore, becoming an important research site for scholars interested in studying the social construction of technology (Marres, 2105). In particular, we focused our attention on Twitter as previous studies have highlighted an increasing relevance of this social media platform as a research site for tracing the discursive evolution of new technologies (Chow-White et al., 2018; Marres & Moats, 2015). The platform provides large quantities of publicly available data from a wide variety of accounts over time and space. Furthermore, the short message format of tweets simplifies the qualitative approach to content analysis through human coding. Previous studies pointed out the platform's almost ubiquitous integration into online and offline social practices (Van Dijk, 2013) and investigated its use during political elections (e.g., Murthy, 2015), health crises (Chew & Eysenbach, 2010), and mass protests (Hofheinz, 2011).

However, the study of meaning creation on Twitter raises some theoretical and methodological challenges and offers the opportunity to apply some of the key tenets of science and technology study in new digital contexts. Twitter is an ideal place where alternative interpretations of blockchain can be observed and studied. Instead of limiting ourselves to constructivism's first symmetry principle, we treat them all as equivalently valid or plausible, regardless of whether such interpretations, or visions for future applications, are technically feasible. Twitter is also a unique research site because of the peculiar forms of interaction this platform prescribes to users. Some studies approach online conversations on Twitter as a form of "talk" or everyday speech reproducing existing public perceptions and cultural values (Murthy, 2015; Jungherr, 2014). Those studies

emphasize the fact that Twitter data gives access to naturally expressed language that is not as staged or engineered compared to formalized interviews and surveys (Jungherr, 2014). Other studies, instead, contest Twitter's neutrality as a content intermediary because of the role that bots, advertising, and spam play in determining what's visible and trending within the platform (Jones, 2019). In line with the second symmetry principle, the one between human and non-human actors, in this research we treat all discourses occurring on Twitter as equally relevant, regardless of whether they were promoted by human users or automated bots. Lastly, scholars have raised concerns about the technical limitations of Twitter as a research site, in particular in respect to both Twitter's ranking algorithm transparency and to the restrictions on the amount of data made available through the platform's streaming API (Driscoll & Walker, 2014; Morstatter, Pfeffer, Liu, & Carley, 2013; Wang, Callan, & Zheng, 2015).

In addition to the first two symmetry principles, we address Twitter's limitations as a research site through Marres and Moats third symmetry principle, which considers both the medium and the content as equally important when studying a particular technological controversy on social media (Marres, 2015; Marres & Moats, 2015). This position argues that when analyzing controversies unfolding on digital media, we should not aim for discursive purity, i.e. we should not try to isolate true discourse from the noise introduced by media-technological dynamics (e.g. API data limitations, opaque ranking algorithms, bots, etc.). These media-technological factors, instead, should be considered part of the discourse as they also constitute what users experience in their everyday interactions with social media platforms. This is consistent with people's actual experiences with social media feeds. We interact with the information as a whole as it streams into our devices and make interpretations in real time.

We conceive of blockchain as a technology still in an interpretative flexible state and open to multiple interpretations. This flexibility, we argue, is in part attributable to blockchain's technical features and, in part, to the different meanings that various social groups attribute to it. As it will become evident in the following pages, techno-libertarians, governments, businesses and end-users have very different ideas about what blockchain is and about its potential as a disruptive technology (Karlstrøm, 2014). For example, some actors view blockchain as a technical system while others want it to be a paradigm shift or intervention into the social and economic relations of algorithmic culture. We rely on Twitter data to explore, map, and analyze these interpretations and to understand the users animating these online discussions. Our approach is informed by the Constructivism triple principle of symmetry. Therefore, we consider

technical features of the medium, API limitations, bots, advertising, and spam as equally constitutive of the discourses around blockchain as human-generated (in the literal sense of the term) contents. Our goal is to determine the frames of meanings that are constructed around blockchain technologies. Through the analysis, we explore the implications that controversies can have on the further development and adoption of blockchain. We ask the following research questions:

RQ1: What are the main frames of meaning developed by Twitter users to describe blockchain and its applications?

RQ2: Who is shaping these discourses and what role media-technological dynamics play in the blockchain's rhetorical construction?

Methods

We employed qualitative and quantitative digital media research methods. For the analysis of the most popular frames, we combined a qualitative and quantitative frame analysis of tweets with a digital analysis of the most recurrent phrases and word co-occurrences. This combination allowed us to bring together the strengths of each method, namely the depth that qualitative methods offer with the breadth of quantitative, digital approaches (Freelon et al., 2018; Sumiala et al., 2016). We utilized Botometer in the analysis of Twitter Users. Botometer is a web service that uses machine learning to evaluate the extent to which a Twitter account exhibits similarity to the known characteristics of social bots.

This research is based on a dataset extracted from 'GenaMiner,' a social media data collection platform developed in 2014 at GeNA Lab, Simon Fraser University. The platform collects data through Twitter's Streaming API, an interface giving real-time access to a sample (the data collection cap is around the 1%) of the entire Twitter stream (Dai, 2013; Driscoll & Walker, 2014). Collecting Twitter data presents several challenges: unannounced API changes, lack of documentation, and lack of transparency on the platform's side are only some of the issues researchers working with social media data have to deal with (Bucher, 2013; Morstatter, Pfeffer, Liu, & Carley, 2013). The data retrieved via API are subsequently stored in a local database and made available to researchers via a web-based text analysis tool developed in the researcher's lab. Since its launch in 2014, SocialMediaMiner has gathered over 5 billion tweets. We retrieved tweets containing the word 'blockchain' collected from January 2015 to December 2017. In the definition of our timeframe, we picked two meaningful moments in the history of blockchain. January 2015 is when the term started surfacing on Twitter for the

first time. December 2017, instead, is when Bitcoin's evaluation hit the all-time record, making it a popular subject beyond specialized media and websites (Chow-White et al., 2020). In other words, blockchain and Bitcoin's salience in public discourse went from low to high during that significant period in the technology's development. The query returned 267,512 tweets, complete with metadata (username, date, location, tweet type and language) posted by 105,734 unique users.

Analyzing tweets' metadata, we used pivot tables to sample the most active users based on the number of tweets they sent in the entire dataset and the 500 most retweeted messages because they indicate the audience's main engagement with blockchain technology. This influence-based sampling method (Faris, Roberts, Etling, & Benkler, 2016) enabled us to build a sample that "better represents the overall inclination of the debate" (p.5842) than a purely random sample of tweets. The reason why we relied on retweets as a measure of influence is that they indicate and require a deeper level of engagement from Twitter users. Resharing certain content with one's followers usually requires more commitment as opposed to just scrolling through the newsfeed or liking a tweet. In addition, retweeting allows users to gather information related to specific topics, to share them with communities formed around topical hashtags, and to mark their perspective on an issue (Bruns & Burgess, 2012; Jacobson & Mascaro, 2016, Atefeh & Khreich, 2015). Relying on retweets as a measure of influence has some shortcomings which we are well aware of. Undoubtedly, an automated analysis of the entire dataset could have helped to explore the ‘‘long tail’’ of the dataset, i.e. the hundreds of thousands of tweets that are never, or seldom, retweeted. Instead, focusing on the "head" of the twittersphere through influence-weight sampling, we were only able to map and explore the predominant discourses about blockchain, leaving room for future research to inquire into the more nuanced, and less visible, stories developing around this technology.

Next, we conducted an inductive frame analysis on 500 most retweeted posts. Three coders independently open coded (Strauss & Corbin, 1998) 100 tweets from the top 500 posts in order to identify the main frames (Van Gorp, 2010; Al-Rawi, 2015). Coders identified frames through interpreting the meaning of tweets and the presence of specific keywords and hashtags, as well as asking themselves 'What is this tweet about?'. After the initial round of coding, the three researchers compared and discussed the frames they independently identified. Some of the frames identified at this stage (n=16) included: "Blockchain != Bitcoin" (Tweets dealing with the difference between blockchain and bitcoin), "Cryptocurrencies" (tweets about

cryptocurrencies: prices, predictions, trends), “Mining technologies” (Includes tweets discussing the material aspects of mining, e.g. graphic cards), “Market news” (tweets about companies operating in the blockchain space. Acquisitions, investments, etc.). Through several rounds of deliberation, the coders aggregated the original 16 frames into five main frames and developed the coding protocol. The protocol was tested on a representative sample of the dataset (10% of the sample, n=50), and intercoder reliability was measured using Scott’s Pi (Singletary, 1994, p. 296) and the IR agreement was acceptable (<0.743). The same researchers coded the remaining dataset of the 500 most retweeted posts afterward. This “small-data” inspired approach (Stephansen & Couldry, 2014), while focusing on a relatively small sample of the entire dataset allowed us to develop thick descriptions of the main discourses concerning blockchain. Here, the three coders examined several framing and reasoning devices including lexical choices, quantification and statistics, emotional, logical, and ethical appeals as well as different lines of reasoning and causal connections in their initial and subsequent identification of the frames (Van Gorp, 2010, pp. 91-92). This exercise allowed the three coders to have a clearer framing package and research process that assisted them in analyzing tweets referencing blockchain technology with a shared understanding and an acceptable intercoder agreement.

For the digital analysis of the dataset, instead, we used the text analytics software QDA Miner 5 and WordStat 8 to enhance our assessment of the co-occurrence of words by examining their proximity plots by observing the Jaccard coefficients that statistically measure the strength of connection between certain words and other terms. The coefficient has a range between 0.0 for no co-occurrence and 1.0 for complete co-occurrence (Tan, Steinbach, & Kumar, 2006). We also used a Python script to extract the most referenced hashtags and mentioned users in the entire dataset.

Finally, we used a bot detection software called Botometer (Al-Rawi et al., 2019) by manually examining the top 50 users. This digital tool is a machine learning algorithm that computes bots’ scores based on several variables like each user’s profile, followers, social network, temporal activity, content, and sentiment. Each score is a statistically calculated probability also known as the Complete Automation Probability (CAP) (Botometer, n.d.). As a following step, we used the Python package version of Botometer (https://github.com/IUNetSci/botometer-python) to examine a larger set of Twitter usernames. It would not have been practical to use the same manual approach to examine thousands of users (see Botometer, 2020, for URL to technical method and specifications). Here, the top 10,000 Twitter users were selected who tweeted a total

of 152,208 messages, constituting 56.8% of the total tweets examined in this study. The last 2018 Twitter users in this dataset tweeted 4 times, and we believe that this dataset can give a better insight into the other users' likelihood of being a bot.

Results

In this section we present the results of our three-pronged analysis of the dataset. In the first section we present the results connected to our first research question. Specifically, we discuss the five main frames we identified through the manual coding of the most retweeted messages and the results of our digital analysis of the entire dataset (Table 1). Subsequently, we present the results pertaining to our second research question. Here we illustrate the findings of our analysis of the users animating the blockchain debate on Twitter.

Table 1. The framing analysis of Blockchain Twitter data

No.	Frame	Freq. & Perc.
1.	Promotional	136 (27.2%)
2.	Critical	13 (2.6%)
3.	General News	253 (50.6%)
4.	Educational	37 (7.4%)
5.	Other	61 (12.2%)
	Total	**500**

Frames of Meaning (RQ1)

Our inductive manual analysis of the 500 most popular tweets revealed five main frames: (1) General News, (2) Promotional, (3) Educational and (4) Critical. The last frame, (5) Other is a residual category which, at first, seemed to include spam and unrelated messages. However, further examination led to a re-evaluation of this category and its role in shaping the blockchain Twitter discourse.

Frame 1: General news

This was the dominant frame in our dataset comprising 50.6% of all tweets (Table 1). "General news" includes tweets referring to new Distributed Ledger Technology based services, speculations, and hypotheses about potential new uses of blockchain, as well as news about the "mainstreaming" of the technology. Sometimes these tweets mentioned private companies (e.g. banks, stock exchanges, insurance and consultancy companies adopting blockchain), while other times they involved public bodies such as governmental agencies and international organizations. For example, within this frame we found a tweet about Bank of America CEO Brian Moynihan embracing blockchain as a way to stay ahead of the competition: "Bank of America CEO: Blockchain Interest is About Education

[URL]". Indicative of the kind of attitude found in this frame was a tweet about the possibility to use a new Bitcoin application to solve the Greece's economic crisis which hit the country in 2009 and deteriorated in the following years: "Coinstructors Proposes Disruptive "Blockchain Solution For Greece" Amid Eurozone Crisis; is Bitcoin 2.0 The Answer? [URL]". News in this frame also pointed to potential mainstream applications of blockchain, which would have rendered the technology accessible beyond the limited circle of crypto enthusiasts and early adopters. For example, a tweet in this frame announced the first-ever blockchain based saving account: "Magnr Launches World's First Blockchain Based #Bitcoin Savings Accounts - Latest BTC.sx Product [URL]". Overall, news in this frame promoted a predominantly positive, future oriented perspective of blockchain and its mainstream applications. Chow-White et al. (2020) refers to this techno-booster discourse as "crypto determinism." For these actors, blockchain tends to represent an instrumental solution to all sorts of social, financial, and economic problems.

Frame 2: Promotional

The second most popular frame within our sample was Promotional (27.2% of the sample). Tweets in this frame were mostly about new Initial Coin Offerings (ICOs, also known as Token Sales) and online contests/giveaways. ICOs are like a crowdfunding campaign particularly popular among start-ups in the crypto industry, which involve the creation and sale of new cryptocurrencies "in exchange for payment in other widely-accepted cryptocurrencies or for real money" (Deng, Huang, & Wu, 2018, p. 467). The ICO became very popular in 2017 in negative and positive ways. For example, the People's Bank of China (PBOC) banned this form of crowdfunding in China in the fall of 2017. On the positive side, a number of successful blockchain projects raised capital through an ICO.

The popularity of ICO was reflected within our sample where we found numerous tweets announcing the launch of new ICOs. Most of them had a marked promotional tone, as in the case of this tweet announcing the launch of a blockchain-based social network: "Invest in the Largest Blockchain Social Network! Nexus Social ICO is Live: Interview with CEO". Despite the general hyperbolic tone, not all tweets were of a promotional nature. For example, among the most tweeted messages we found some denouncing shady ICOs, as in the case of the healthcare start-up Patientory: "Warning #Patientory scam: [URL]. Help stop $PTOY #ICO fraud! #Ethereum #Blockchain". A term often found in ICO tweets was "whitepaper" which are documents describing the technical features and the business plan of debuting startups. These documents are meant to provide information and development roadmaps to potential

investors. The release of whitepapers, often done in preparation of an ICO, was usually promoted via Twitter by either the start-up itself or by specialized websites e.g. “We are pleased to announce our #whitepaper! Help us revolutionize the #patent industry using #blockchain [URL]”. Another kind of tweets very popular within this frame were clickbait promoting contests or giveaways. There is no doubt that clickbait are regarded as a major problem for many users and social media platforms (Chen, Conroy, & Rubi, 2015; Chakraborty et al., 2016). These were usually tactics employed by either companies or individuals to gain new followers and visibility within the blockchain twittersphere. An example is provided by the official account of a debuting cryptocurrency that, at the peak of the 2017 Bitcoin bull-run (December 2017), promised to give away 10 Bitcoins (equivalent to $180,000 USD) in exchange for retweets: "I'm back! #myfirstTweet #blockchain #cryptocurrency #Bitcoin One lucky RTer gets 10 BTC at 50,000 retweets or 1/1/18". With 182 retweets, the tweet was the third most-popular message in our sample. Even though it was not possible to assess the truthfulness, or even the legality, of these promotions, they were nevertheless very visible in the dataset we examined.

The promotional frame illustrates how blockchain is in an interpretative flexibility state with contested meanings and various interpretations. This data sheds light on numerous blockchain projects that are building their presence on Twitter and promoting their ICOs. This means various social groups are striving to carve out their online presence and promote their interpretation of what blockchain is through their own proposed projects, specific applications of their technologies, or the unique proposition of their own cryptocurrency.

Frame 3: Educational

Within this frame, we collected all tweets providing advice and/or information about how blockchain, and its applications, work. The results show that 7.4% of the tweets were “Educational”. These tweets were aimed at people completely new to the technology as well as to more experienced users. The tweets intended to share resources, such as tutorials, to enable people to participate in the understanding, development, and adoption of the technology. For example, this tweet linked to a guide explaining the basic functioning of Bitcoin: “What is Blockchain [URL] #IoT #IIoT #IoE #InternetOfThings #blockchain #hyperledger”. While this other tweet shared a guide to Ethereum: "Good one. Beginner's guide to #Ethereum #fintech #ICO #cybersecurity #BigData #VR #blockchain #AI #bitcoin [URL]" It is interesting to note how, through hashtags, users tried to gain visibility within the blockchain topical community and within other potential fields of application of distributed ledger

technologies (internet of things, virtual reality, big data, etc.). Another group of tweets within this frame referred to live events and conventions. For example, in this tweet a blockchain based company invited its followers to meet its team at a Microsoft-sponsored event: "CEO of MinexSystems on Microsoft Blockchain Event. You can meet our devs and CEO on this grate [sic] event today and tomorrow".

Frame 4: Critical

We also found another group of tweets that are critical of the blockchain technology (2.6%). However, the low percentage of retweeted posts seems to indicate that users did not fully engage in critical discussions about blockchain. These tweets often had a skeptical tone and pointed to some limitations of the technology in matters of privacy and security. For example, within this frame we found a message, retweeted 132 times (fifth most popular tweet in our sample) denouncing the lack of transparency of distributed ledger technologies: “Humanity is expected to pay for the #IoT and #bigdata, #blockchain without any input on how it works, NO thanks #USOP #UOSPA”. Other tweets denounced the hacking of blockchain-based technologies, as in the case of this tweet: “Pantera Capital @USER is hacked. Their site is down at the moment. Investors be careful. #bitcoin #blockchain". Lastly, it was interesting to find in our sample mentions to Silk Road, the infamous website that in 2011 was involved in an international crime scheme for the sale of drugs online: “‘I have secrets’: Ross Ulbricht’s private journal shows #SilkRoad’s birth [URL] #anonymity #privacy #darknet” . This is an important frame because it tends to be a skeptical viewpoint that pushes back on the ability of blockchain to solve problems. The booster vs skeptic dynamic is a key feature of a technology in a state of interpretive flexibility.

Frame 5: Other: The spam or significance of ‘Hashtag Piggybacking’

Finally, ‘other’ (12.2% of the sample) deals with tweets that, prima facie, might appear irrelevant, spam, or not directly related to blockchain. Many posts in this category contained retweets that only used a series of hashtags like #bitcoin and #blockchain. These messages seemed to be used by spam and automated bots as a way to gain visibility and followers. However, true to the third principle of symmetry discussed above, we decided not to exclude these tweets from our sample and, instead, to analyze which role they might play in the construction of frames of meaning. The most apparent feature of these tweets is the use, and abuse, of hashtags. While this practice might be considered a form of spam, ‘hashtag piggybacking’ actually plays a role in the definition of the discourse. For example, through hashtags, blockchain is put in relation to other technological trends, mostly with the Internet of things, big data,

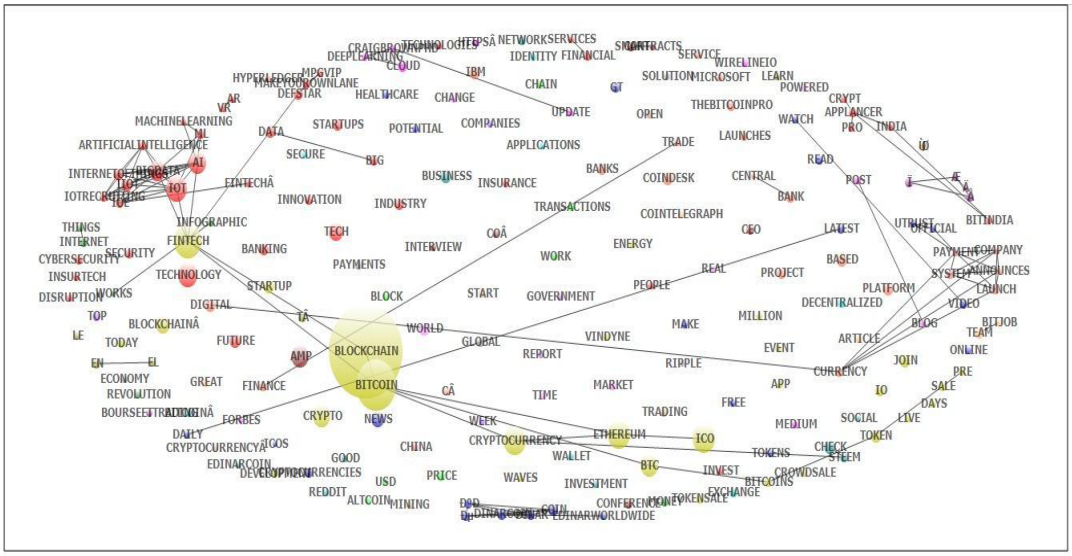
artificial intelligence, and fintech. For example, one account in our sample tweeted regularly using a sequence of hashtags which criss crossed current technological topics: “Connected Motorcycles and #IoT [URL] #InternetOfThings #IoE #IIoT #AI #BigData #BlockChain #Fintech”. Connections were not established only among technology hashtags, but also with semantic fields not closely related to blockchain such as adult entertainment. It was the case of a Las Vegas gentlemen’s club regularly barging into the blockchain twittersphere promoting their services, and their own cryptocurrency: “No one does weekends like $LGD. #ufc217 & @BrodyJenner #bitcoin #blockchain #crypto #vegas #ethereum”. These tweets were highly retweeted (the most retweeted tweet in our dataset was from this club), and coloured the blockchain conversation without necessarily tweeting about the technology itself or directly promoting it. These tweets can build new meanings by association. For example, hashtag piggybacking connects blockchain to other positively connotated and more established technologies such as big data and Internet of things (IoT).

Analysis of the Most Recurrent Phrases and Word Co-occurrences

The frame analysis provides a nuanced, idiographic perspective on a very specific sample that garnered most of the audience’s attention (n=500). In this section, we illustrate the quantitative findings of our digital analysis of the entire dataset (n=267,512). We hope our mixed method helps paint a fuller picture of the kind of discourses circulating on Twitter about blockchain.

Figure (4) shows a visualization of the top 100 most frequent words in the text corpus that provide an idea of the kind of mostly positive technological terms that are often used on Twitter in relation to blockchain. We can see that the words are mainly related to the banking systems, new crypto currencies, and new technologies like big data, machine learning, Internet of Things, and artificial intelligence. We suggest the association with these new technologies is meant to further promote blockchain. By hashtag piggybacking blockchain to AI or IoT, for example, the goal and effect of these tweets may be to present blockchain as relevant and promising by association. The promotion strategy is to increase positive sentiment and saliency of blockchain by inserting it into established discourses about technologies further along Everett Roger’s (1983) adoption curve. This kind of discursive move also connects to the educational frame, which tends to point people towards blockchain 101 type resources. Where education explains what blockchain is, promotional hashtag piggybacking what blockchain is like.

Figure 4. A visualization of the top 100 most recurrent words and their associations.



In addition, the identification of the top 50 most frequent phrases (4-5 words) used by the online audience provide more insight into these discussions (Table 2), for the majority of phrases carry strong positive undertones like “technologies to drive the future” (n=159), “technology will be the greatest” (n=144), and “Blockchain is the future” (n=108). The second phrase is part of a larger retweet that reads as follows: “@DNotesCoin: "#blockchain technology will be the greatest technological revolution since the Internet” (72 retweets). As mentioned in the analysis of the promotional frame (frame #2), many retweeted posts are clickbait that promise Bitcoin rewards for viewing certain websites or registering and playing some video games. The goal of the other most retweeted posts seems to spread news on blockchain like announcing a Nigerian cryptocurrency called E-Dinar. In fact, @e_dinarcoin, an account that is currently suspended for violating Twitter rules, is the second most mentioned user in our dataset. These clickbait function as promotional actors, while many other retweeted posts contain news about blockchain, as in the case of the already mentioned Las Vegas gentlemen’s club announcing a new digital token called $LGD. In its efforts to attract more customers, the club announced that it accepts Bitcoins as a method of payment in addition to its own new digital tokens.

Table 2. The top 50 most recurrent phrases in the Twitter corpus (4-5 words).

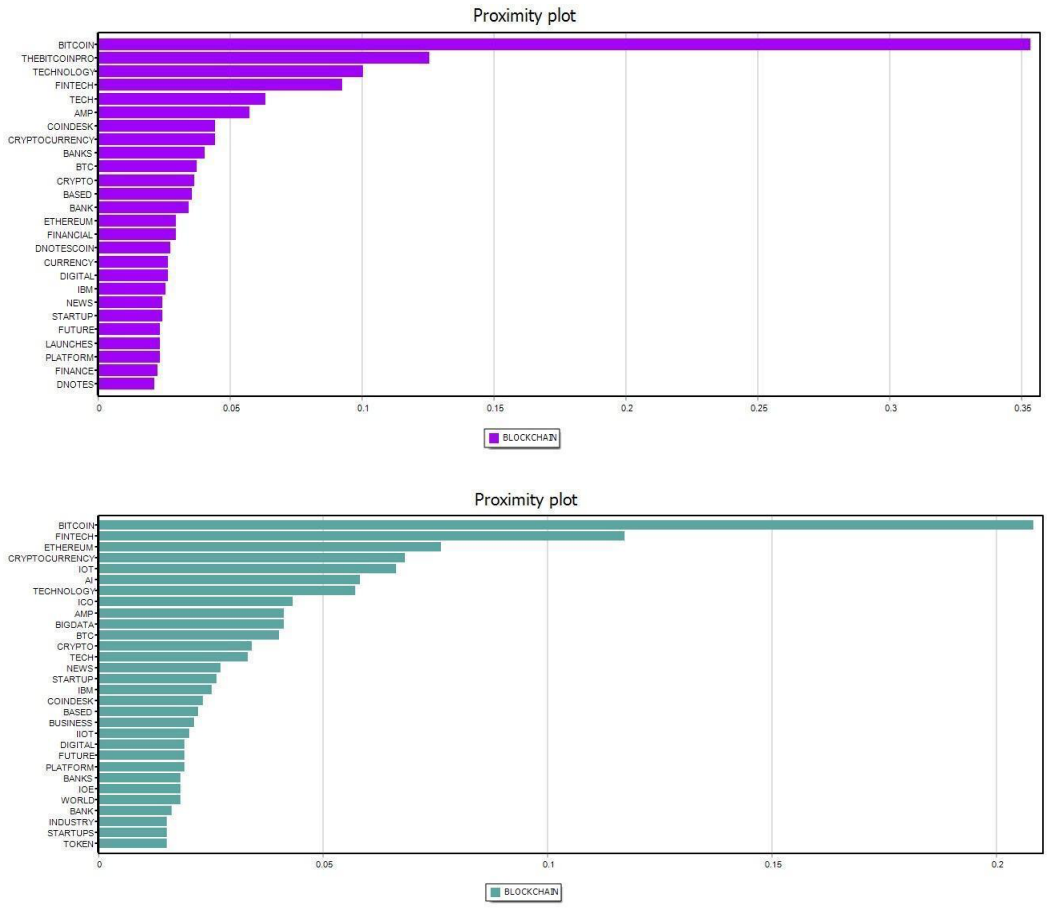
No.	Phrase	Freq.	No.	Phrase	Freq.
1.	Dnotes Announces New Company Launch	413	26.	Bitcoin And Blockchain Technology	116
2.	Blockchain As A Service	409	27.	Internet Of Things Https	116
3.	Average Price Of Bitcoin	403	28.	Bitcoin Block At Height	115
4.	Bitcoin And The Blockchain	313	29.	Movement In These Buzzing Assets	114
5.	Dnotes Co Founder Alan Yong	236	30.	Directly With The Team	113
6.	Founder Alan Yong Interview	236	31.	Blockchain Insights And Future	111
7.	Freebitco Now Give You Reward	208	32.	Newest Video Series Ico Insider	110
8.	Step By Step Guide	166	33.	Series Ico Insider My Tips	110
9.	Technologies To Drive The Future	159	34.	Tips For The Hottest Ico	110
10.	Alan Yong Interview On Digital	157	35.	Guide For Beginners Https	109
11.	Yong Interview On Digital Currency	157	36.	Blockchain Is The Future	108
12.	Emerging Technologies To Drive	145	37.	Tickers Trending On Twtr	108
13.	Watch Our Latest Youtube Video	145	38.	Activity Marketplace On Ethereum Blockchain	107
14.	Technology Will Be The Greatest	144	39.	School Activity Marketplace On Ethereum	107
15.	Technological Revolution Since The Internet	139	40.	Blockchain Leader Hashingspace Secures Accounting	104
16.	Blockchain Without Any Input	132	41.	Blockchain Powered Education Platform	104
17.	Fortress One Data Center	132	42.	Hashingspace Secures Accounting And Consulting	104
18.	Humanity Is Expected To Pay	132	43.	Powered Education Platform With Scholarships	104
19.	Input On How It Works	132	44.	Education Platform With Scholarships Https	103
20.	Invest In The Largest	130	45.	Social News Alert Â	103
21.	India On Blockchain Insights	127	46.	Assets Are Seeing A Jump	102
22.	Blueprint For A New Economy	126	47.	Change The World Https	102
23.	Key And Emerging Technologies	126	48.	Secures Accounting And Consulting Services	102
24.	Step Guide For Beginners	123	49.	Consulting Services From Urish Popeck	101
25.	Alt Convention Conference Invites	121	50.	Londonrealtv Interview With Marc Goodman	101

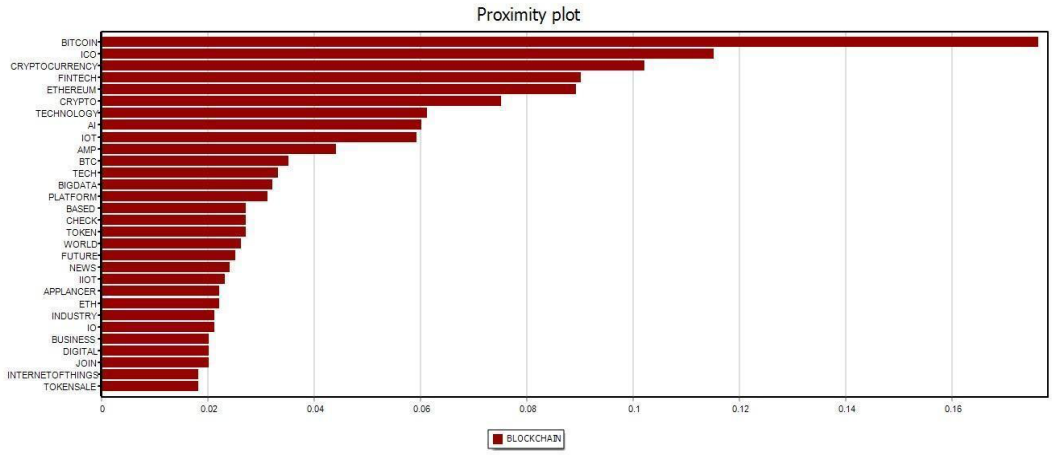
Next, we measure proximity plots to statistically measure the strength between one word and another. We find that the word “blockchain” is mostly connected to Bitcoin (J=0.228) followed by Fintech (J=0.103), Cryptocurrency (J=0.080), Ethereum (J=0.078), and ICO (J=0.070) (Table 3). However, the strength between blockchain and Bitcoin varies significantly over time. For example, in the period between January 2015 to June 2016 during which the DAO hack occurred, we find the strongest connection (J=0.353), followed by (J=0.208) in the period between June 2016 and September 2017 during which China banned ICO, and (J=0.176) in the period between September 2017 and December 2017 when blockchain became more popular. This shows that the online audiences mostly refer to blockchain in connection to Bitcoin, but this link has gradually weakened presumably as new entrants gain more attention and the space diversifies beyond cryptocurrency to many different types of uses and applications. This is also evident upon examining the percentage of cases or sentences containing the above two words in the text corpus, for it is 34.57%, 20.01%, and 14.50% in the first, second, and third periods consecutively (Figure 5).

Table 3. A proximity plot of the word 'Blockchain' in the Twitter corpus.

No.	Keyword	Co-occurs	Jaccard coefficient
1.	Bitcoin	59531	0.228
2.	Fintech	26723	0.103
3.	Cryptocurrency	20379	0.08
4.	Ethereum	19865	0.078
5.	ICO	17984	0.07
6.	Technology	15926	0.063
7.	IOT	15164	0.059
8.	Crypto	12754	0.05
9.	AI	12408	0.049
10.	AMP	11063	0.044
11.	BTC	10195	0.04
12.	Bigdata	9349	0.037
13.	Tech	9149	0.036
14.	News	6419	0.025

Figure 5. The proximity plot of "Blockchain" during the three periods*.





*(1) purple: (January 2015 - June 2016) / (2) blue: (June 2016 - September 2017) / (3) red: (September 2017 - December 2017).

Also, the word “Ethereum” is actually absent in the top 10 most connected words that are linked to blockchain in the first period (ranked no. 14). This is interesting because Ethereum is the second largest blockchain and is the second wave of the technology or blockchain 2.0 (Swan, 2015). The Ethereum blockchain is much more flexible and powerful than the Bitcoin one. Developers can create smart contracts that can enforce a wide and diverse set of programmable relationships between actors. Also, actors can build other platforms and applications on top of Ethereum, which acts as a blockchain operating system. For example, many of the most popular blockchain projects are built on top of Ethereum. Ethereum gradually became recurrent in the second period (J=0.076) and gained a stronger connection in the third one (J=0.089). The same applies to ICO (Initial Coin Offering) which was weakly connected in the second period (J=0.043) but gained momentum in the third one (J=0.115). As for IOT (Internet of Things), it was also absent in the first period only to emerge in the second one (J=0.066) but slightly weakened in the third period (0.059) (Figure 5). This indicates the dataset straddles blockchain 1.0 (Bitcoin) and 2.0 (Ethereum and smart contracts) and shows a shift from the single use of blockchain as Bitcoin, to more efficient and expansive smart contract driven blockchains. Finally, the examination of the top hashtags used in the dataset shows a similar pattern for #blockchain is the most referenced one (n=128,295) followed by #Bitcoin (n=44,522), #fintech (n=21,615), #cryptocurrency (n=15,514), and #ethereum (n=13,956) (See Table 4).

Table 4. The top hashtags extracted from the entire dataset.

No.	hashtags	Freq.	No.	hashtags	Freq.
1.	blockchain	128295	26.	cryptocurrencies	1914
2.	bitcoin	44522	27.	tokensale	1780
3.	fintech	21615	28.	ml	1630

4.	cryptocurrency	15514	29.	deeplearning	1537
5.	ethereum	13956	30.	startups	1456
6.	iot	11941	31.	industrialiot	1449
7.	ico	11780	32.	innovation	1378
8.	ai	9374	33.	banking	1347
9.	crypto	8415	34.	reddit	1311
10.	bigdata	8108	35.	cybersecurity	1287
11.	btc	7327	36.	medium	1245
12.	iiot	5554	37.	crowdsale	1239
13.	internetofthings	4637	38.	insurtech	1229
14.	technology	3431	39.	machinelearning	1213
15.	tech	3428	40.	finance	1176
16.	ioe	3115	41.	ibm	1166
17.	steem	2534	42.	datascience	1072
18.	eth	2402	43.	altcoin	1070
19.	artificialintelligence	2357	44.	trading	1056
20.	startup	2314	45.	digital	1023
21.	news	2305	46.	healthcare	1019
22.	bitcoins	2225	47.	cryptos	1001
23.	business	2160	48.	disruption	927
24.	cloud	2084	49.	39	909
25.	token	1930	50.	payments	909

Who's Tweeting about Blockchain? (RQ2)

In order to further understand who is mostly behind this activity, we examined the most active users who tweet about blockchain, and we found that the majority carry usernames that are connected to cryptocurrencies like alt_bit_coins (n=3401), HELPSCOIN (n=1659), AltcoinsBank (n=1215), BitcoinAgile (n=1164), etc. Further, at the time of the analysis, Twitter removed half of the top 10 accounts allegedly for violating Twitter automation rules. Three more scored over 3 out of 5 in their likelihood of being bots (Table 5) according to Botometer (0 means more likely to be human, 5 is more likely to be a bot). In other words, there is a clear push by cryptocurrency enthusiasts, traders, and companies to popularize blockchain technology by using automation to disseminate positive news about it as wide as possible. The investigation of the most active users provides further insight into the framing analysis stage presented above. It shows how bots and automated systems for posting and sharing contents are furthering what we have defined as "General news" and "Promotional" tweets. In this manner, critical blockchain voices (Frame #3), potentially key in defining the technology by pointing out its limitations and flaws, run the risk of being overwhelmed by promotional and bot-enhanced contents. Referring back to our theoretical framework, the tendency to rely on bots to promote one interpretation of blockchain might limit its flexibility by

giving one set of actors, or social group more visibility over others.

Table 5. Top 10 most active Twitter users in the three datasets overall users*

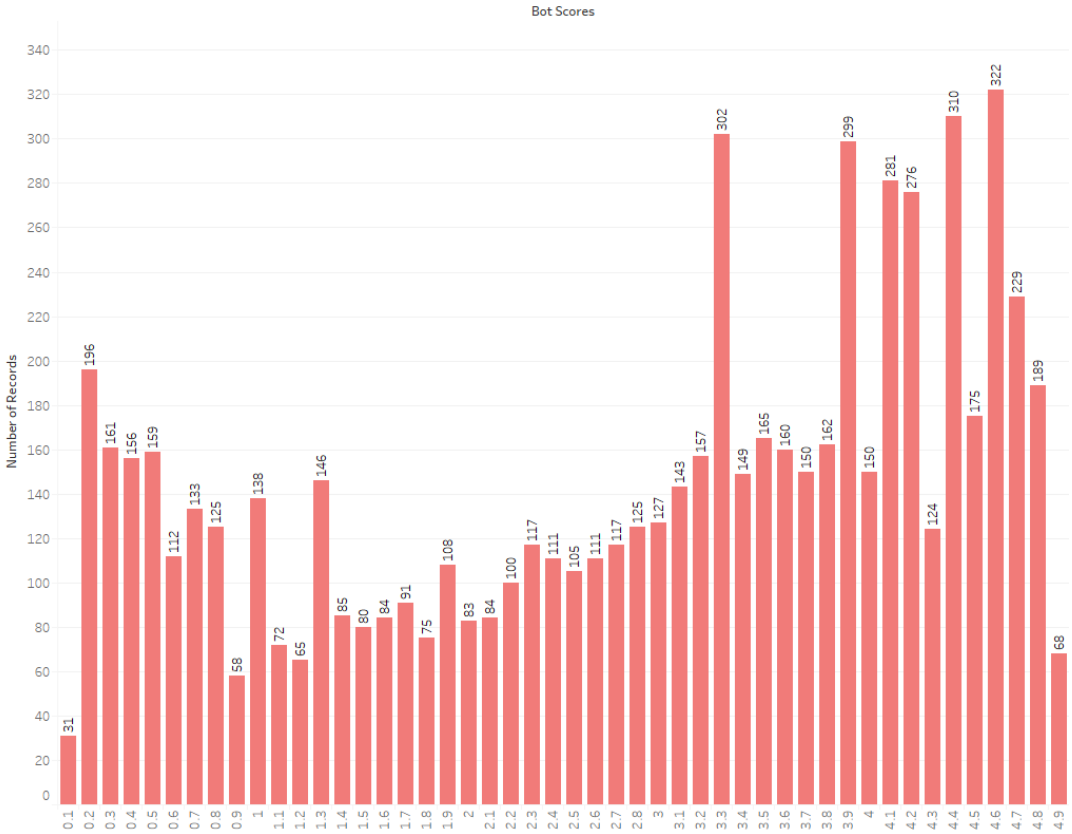
First dataset (January 2015 - June 2016)				**Third dataset (September 2017 - December 2017)**			
No.	Users	Freq.	Bot score	No.	Users	Freq.	Bot score
1.	AltcoinsBank	675	2.1	1.	StakepoolCom	697	---
2.	HELPSCOIN	623	---	2.	mamoru_io	403	---
3.	alt_bit_coins	516	---	3.	alt_bit_coins	347	---
4.	ReddBazaar	273	4.7	4.	StartUpRealTime	312	1.6
5.	BitcoinzMachine	265	---	5.	TopFiveTraders	287	3.4
6.	CoinfeedIO	252	3	6.	bitcoinagile	240	3.8
7.	BitcoinzWoman	240	---	7.	topnewskoeln	210	---
8.	e_worths	225	4.5	8.	CryptoCurrent	202	3.3
9.	BitcoinzMan	222	---	9.	Voltairein	202	---
10.	cryptograbber	216	---	10.	BlockChainGO	199	4.3
Second dataset (June 2016- September 2017)				**All users**			
Rank	Users	Freq.	Bot score	No.	Users	Freq.	Bot score (1-5)
1.	alt_bit_coins	2296	---	1.	alt_bit_coins	3401	---
2.	HELPSCOIN	978	---	2.	HELPSCOIN	1659	---
3.	StakepoolCom	849	4.5	3.	StakepoolCom	1646	---
4.	24cryptonews	810	---	4.	AltcoinsBank	1215	2
5.	StartUpRealTime	750	1.6	5.	BitcoinAgile	1164	3.5
6.	bitcoinagile	683	3.8	6.	StartUpRealTime	1143	3
7.	btcnws	516	3.2	7.	24cryptonews	1122	---
8.	AltcoinsBank	475	2.1	8.	mamoru_io	813	---
9.	ReddBazaar	445	4.7	9.	ReddBazaar	773	4.7
10.	UnchainedBlock	399	---	10.	topnewskoeln	658	---

As stated above, the majority of the most active users seem to be bots rather than humans. This shows that the kind of new technology is mostly popularized by automated accounts created by humans, possibly to maximize the outreach of promotional hashtags and tweets that discuss blockchain. For example, the examination of the top users in the first period (January 2015 - June 2016) shows that only one account scored less than three out of five (zero being human and five a bot), according to the Botometer website. Twitter suspended six accounts for violating Twitter rules on the maximum number of messages sent. The same applies to the other two periods that also have a high number of bots (8/10) and (9/10) in the second (June 2016- September 2017) and third (September 2017 - December 2017) periods consecutively (Table 5). Indeed, this activity has important implications for who is behind the popularization of this new technology, as will be further explained below.

Also, our examination of the top 10,000 users shows there were

3,034 accounts (30.4%) whose scores were not generated mostly due to the fact that these accounts were removed by Twitter. Out of the remaining accounts, the average is 2.8 which is interesting because it shows that the majority are above the middle score. Further, the highest score was 4.6/5 followed by 4.4/5 and 3.9/5 which are all accounts that are likely to be bots (Figure 6). To provide a breakup of these scores, 2124 accounts scored 4 and above constituting 30.4% of the examined accounts, while 1814 accounts scored 3 and above representing 26%.

Figure 6. The bot scores of the top 10,000 Twitter users.



The same observation can be noted in the examination of the top retweets from the first period that only contain news on and updates about blockchain that were originally sent by two main users @DNotesCoin and @BitcoinPRBuzz. The first one is the Twitter handle of DNotes, a Chicago based digital currency company, while the second one describes itself as follows: “Massive PR services for all things #Bitcoin. Early 100% Bitcoin business!” The goal of the two accounts as well as other similar ones is to positively promote cryptocurrency and popularize its use by the public, and their efforts seem to be aided by a certain number of bots, as indicated above. Again, the findings reveal that there are intentional, predominant and ongoing attempts to frame the blockchain technology in positive ways even if one takes into account the active bots that have been detected since these accounts are initiated and/or programmed by

humans to perform certain automated tasks.

Conclusion

As new blockchain applications and cryptocurrencies emerge, social media become the key channels to increase visibility of specific projects, draw attention of the community and investors and organize successful ICOs. Our frame analysis revealed that most Twitter users, in the period of our analysis, talked about blockchain in association with future applications of the technology (Frame 1) and ICOs (Frame 2). It was interesting to find a small subset of critical tweets discussing the drawbacks of the technology and also "policing" the space by pointing out frauds and hacks (Frame 4). Overall, the majority of messages showed a future oriented, promotional and positive attitude (RQ1). In particular, the analysis of the top 50 most frequent phrases suggests that the discourses circulating on Twitter about blockchain reflect the kind of crypto-deterministic narratives popularized by mainstream and specialized media, which portray blockchain as a rational and neutral technology for the organization of the economy and society at large (Chow-White et al., 2020). In addition, the analysis of word co-occurrences shows how the association between blockchain and Bitcoin has weakened over time, signaling a shift from blockchain as Bitcoin to blockchain as an enabling technology. True to the first principle of symmetry, the goal of this paper was not to evaluate nor predict the likelihood of a particular application to become successful. Instead, we tried to represent blockchain in all its ramifications and facets.

When we think of social construction of technology, we too often associate it with an organic process taking place among social groups. In other words, as a process of deliberation that occurs among cognizant humans. As our research has revealed, sometimes this process of construction is actively participated by other actors such as bots, PR companies, and spammers who only tweet using relevant hashtags. In line with the second principle of symmetry, we attempted to show the substantive role that these actors have in the construction of discourses about blockchain. As shown in our analysis of the most active users, bots are very visible and active in the blockchain Twittersphere. Their participation in the conversation is relevant because, while they might not add new contents, these actors function as connectors between different hashtags and topical communities. In doing so, they create opportunities for other users (including humans) to generate new meanings out of these connections (RQ2).

As Feenberg (2017) pointed out, the (online) public as well as other active communities can redesign and reshape new technologies with their various inputs, perspectives, and critiques. Indeed, this typically

applies to blockchain technology mostly because of the decentralized nature of this new technology. Since we are still in the early stages of blockchain development, it is expected that divergent views will emerge (Bijker, Hughes, & Pinch, 2012), which is one of the findings of this study. However, the majority of public discourses about this new technology highlighted positive attributes towards it which might have a possible impact on the general public in their mental construction of meaning toward blockchain.

Finally, this study is limited in two main ways. First, the time period spans about 3 years only (January 2015 to December 2017). While this is a significant time period in blockchain development and public discourse, it provides us with only a single chapter in its unfolding story. It would be helpful if future research could examine the more recent online discourses towards blockchain. It would also be interesting to understand how the discourse changed over time through a longitudinal analysis that covers a number of years and phases of the blockchain and Bitcoin life cycle. As the technology evolves, new terminology and language emerge around specific blockchain applications and services. This means that conversations around blockchain might not be always searchable on Twitter under the generic keyword 'blockchain' and there is more room to examine the development of the discourse in the future research by expanding on other query words. Second, the Twitter collection platform that we used is limited due to API rules, so not all the tweets referencing the new technology were collected. Also, in this case the third symmetry principle invites other scholars to reflect on the media-technology features and to consider them as a constitutive part of the research field instead of their limitations. Further, we did not separately study the tweets sent by bots as this aspect could shed light into the nature of automated accounts' messages because our goal was to examine the public online discourses as a whole.

Future analysis of users could dig into deeper levels of the discourse and rhetorical moves. For example, how did discourse from bots accounts may differ from discourse from human accounts? A similar analysis could be done to understand how different users deployed different frames. Future research could also dig deeper into the individual frames such as studying their most frequent phrases, words, and word co-occurrences. Investigating other social media platforms like Telegram, YouTube, Instagram, and Facebook individually could reveal further and comparisons amongst them. Future studies can also examine cross-national differences to further understand the international discourses on blockchain. Special attention can be paid to contexts other than the Global North, as in the cases of the blockchain based central bank digital currency in Barbados or projects working to connect the unbanked such as OMG

Network in Southeast Asia. Blockchain is a rapidly developing global technology, and the COVID-19 pandemic has shown that people around the world are increasingly reliant on various technologies to communicate, carry out everyday activities, and execute business interactions. We are witnessing how blockchain-based technologies have been rapidly adopted and utilized by national governments and major corporations, pushing this technology into the mainstream, and the pandemic accelerated this kind of adoption. The future changes in the adoption and diffusion will most likely unfold in ways that repeat, echo, and diverge from the frames we found in this study as actors and non-human actors continue to construct discourse on social media.

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To cite this article:

Chow-White, P. A., Al-Rawi, A., Lusoli, A., & Phan, V. T. A. (2021). Social construction of blockchain on social media: Framing public discourses on Twitter. *Journal of Communication Technology, 4*(2), 1-31. DOI: 10.51548/joctec-2021-008.