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Rethinking the "social" in "social media": Insights into topology, abstraction, and scale on the Mastodon social network

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Abstract

Online interactions are often understood through the corporate social media (CSM) model where social interactions are determined through layers of abstraction and centralization that eliminate users from decision-making processes. This study demonstrates how alternative social media (ASM)—namely Mastodon—restructure the relationship between the technical structure of social media and the social interactions that follow, offering a particular type of sociality distinct from CSM. Drawing from a variety of qualitative data, this analysis finds that (1) the decentralized structure of Mastodon enables community autonomy, (2) Mastodon's open-source protocol allows the internal and technical development of the site to become a social enterprise in and of itself, and (3) Mastodon's horizontal structure shifts the site's scaling focus from sheer number of users to quality engagement and niche communities. To this end, Mastodon helps us rethink "the social" in social media in terms of *topology, abstraction*, and *scale*.

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In mid-2017, Mastodon, an open-source, decentralized microblogging system developed by Eugen Rochko, was caught up in what we would call an "Alternative Social Media Killer Hype Cycle" ("Killer Hype Cycle," for short). Killer Hype Cycles are often seen in tech reporting on alternatives to mainstream social media platforms, such as Facebook and Twitter. The cycle goes like this: first, a journalist notices a fledgling alternative social media (ASM) system. Looking for a click-worthy angle, the journalist declares it the next "Facebook Killer" or "Twitter Killer," arguing that within months, the corporate social media (CSM) giant will be "killed" because its users will leave en masse for the new alternative. Later, when someone notices that Facebook or Twitter is still active despite the presence of the "Killer," another journalist (or even the original journalist) will declare the alternative a "failure" or simply "dead," mainly because it did not attract hundreds of millions of new users in a matter of weeks. The cycle appears to end—that is, until another alternative is noticed by a tech reporter, and the cycle is repeated.

Previous ASM caught in this cycle include diaspora*, which in May 2010 was dubbed a "Facebook killer" by journalists (Tate, 2010). Not even a month later, *Business Insider* ran a story with the snarky headline "Remember Diaspora? The Would-Be Facebook-Killer Is Still Underway For Some Reason" (Saint, 2010). Later, in 2014, Ello was also dubbed a "Facebook killer" in stories in *The Washington Post* (Dewey, 2014) and *The Atlantic* (Eveleth, 2014). By April 2015, the *Post* asked, "Whatever happened to Ello, the social network that was supposed to kill Facebook?" (Hatmaker, 2015). For its part, Mastodon, the subject of this study, was dubbed a "Twitter killer" in April 2017 (Miriam, 2017). And, like diaspora* and Ello before it, Mastodon saw the end of the Killer Hype Cycle when journalists argued that it failed to replace Twitter (Ulanoff, 2017).

The Killer Hype Cycle may help tech journalists produce stories on ASM. However, the cycle does not tell us much about the alternatives themselves. Rather than indulge in an academic version of the Killer Hype Cycle, this analysis is dedicated to exploring how the sociotechnical structure of ASM redefines the fundamental social relationships inherent to CSM. This study thus ignores the overly simplistic, zero-sum creative destruction narrative so often deployed in stories about ASM and instead considers Mastodon as an innovative new approach to online social interactions that helps us rethink "the social." Specifically, we consider how the Mastodon platform puts the "socio" in "sociotechnical" by creating new articulations between online sociality and platform politics. As we will show, Mastodon's reconfiguration of the social in social media appears in three related concepts: *topology, abstraction*, and *scale.*

Background: Alternative Social Media and Mastodon

Alternative media is broadly defined as any "media production that challenges at least implicitly, actual concentrations of media power, whatever form those concentrations may take in different locations" (Couldry and Curran, 2003: 7). ASM provide a challenge

to the concentrated power of CSM sites—Facebook, Twitter, Instagram, LinkedIn, and so on—that control and define much of our personal and professional experiences today (Gehl and Snyder-Yuly, 2016). Although CSM still dominate social networking, ASM provide a welcome alternative for those seeking more privacy in and control over their online networks.

One such site with recent success in redefining social media is Mastodon. Created in 2016 by 24-year-old German student and software developer Eugen Rochko, Mastodon was built as a response to the increasing dissatisfaction with Twitter. Off to a slow start, Mastodon saw its first explosion of usage during April 2017 (from approximately 20,000 to over 100,000 users; see Rhodes, 2017), a moment that also included the start of Mastodon's "Killer Hype Cycle." Mastodon's userbase has steadily increased since then, hitting 1 million users in December 2017. According to a fediverse.network audit, Mastodon currently boasts approximately 2.9 million users and 2837 instances (a term used to describe Mastodon communities; further explained below) (Fediverse Network, 2019).[1] Much like previous ASM sites, such as rstat.us (Gehl, 2015a) or Galaxy2 (Gehl, 2015b), Mastodon attempts to restructure the often-hostile environment that now characterizes many popular CSM sites (Lekach, 2017). Mastodon replicates many features of Twitter and Reddit. Similar to Twitter, users create accounts, follow other users, and post short status updates. Unlike Twitter, Mastodon users "toot" instead of tweet and "boost" instead of retweet. Moreover, Mastodon affords "content warnings," which are short summaries of toots that can preview potential disturbing content (e.g., frank discussions of experience with sexual assault or contentious political debates). Similar to Reddit, Mastodon emphasizes niche communities and content moderation. Users on both sites curate the content they see, albeit in different ways (e.g., following a subreddit and using upvotes/downvotes on Reddit; writing the code for a Mastodon community; see Massanari, 2017). However, subreddit communities are still governed by Reddit administrators whose control spans across the site, whereas Mastodon communities are structurally independent of one another.

Much like ASM in general, Mastodon remains understudied. To our knowledge, there are no academic studies that examine Mastodon as an alternative to corporate media and an important technosocial configuration in and of itself. This article thus attempts to fill this gap by examining how Mastodon restructures common expectations for social media engagement.

Methods and data collection

We frame our analysis and discussion of Mastodon's unique sociotechnical configuration through a grounded theory and platform studies approach. Grounded theory is an inductive qualitative research approach aimed at theory development (Glaser and Strauss, 1967). Grounded theory emerged out of an interpretivist episteme that privileges symbolic interaction and contextually bound truths (Clarke, 2005). It argues against "armchair" theorizing and instead emphasizes the need for bottom-up theorization derived from the empirical data collected for analysis (Corbin and Strauss, 2015: 6). In this sense, grounded theory blurs the lines between "generating theory and doing social research [as] two parts of the same process" (Glaser, 1987: 2). To analyze data, grounded theory

makes use of a constant comparison approach, where a variety of data are broken down into manageable pieces and compared for similarities and differences (Glaser, 1965).

For this study, we cultivated a wide range of data from the following six sources. (1) Interviews with five Mastodon instance administrators conducted between October 2017 and April 2018, all of whom gave informed consent to be interviewed (names anonymized upon request). Interviewees were selected after an examination of the instance list available on instances.social, a comprehensive list of Mastodon installations. We contacted administrators running instances older than 3 months and having at least 100 active users, and 5 consented to be interviewed. Administrators were asked about their experience hosting websites, motivations for becoming administrators, the relationship between CSM and ASM, moderation policies, instance size, and federation decisions (a term that describes Mastodon's topological structure; further discussed below; see Appendix 1). (2) Participant observations on three Mastodon instances—a Dark Web instance, a "generalist" instance on the standard Web, and a specialized instance—conducted between October 2017 and August 2018. (3) Publicly available Mastodon toots tagged with #federation. Through participant observation, we found that this tag was consistently associated with discussions of Mastodon itself. (4) Nearly 400 screenshots and text extracts of Mastodon's sign-up interface, which is a key moment in social media use (Friz and Gehl, 2016), and codes of conduct, archived in the Social Media Alternatives Project (S-MAP; https://socialmediaalternatives.org/archive/items/browse?tags=mastodon). (5) Thirty-six publicly available discussion forum and blog posts from Mastodon instance developers, including blog posts in the software repository. Finally, (6) news coverage of Mastodon, which primarily appeared in technology journalism (e.g., WIRED, TechCrunch).

After an initial round of data collection, the first pass over the data revealed three emergent theoretical concepts that acted as a lens to further refine our analysis: topology, abstraction, and scale, which are elaborated below. These concepts were used to return to the data and compare the artifacts gathered. Because the concepts that emerged from the initial analysis are technical in nature, in our subsequent analyses, we also drew from platform studies, both as a means to investigate Mastodon as a platform (McKelvey, 2011) and critically engage with CSM platforms (Langlois, 2015). Platform studies is a "set of approaches which investigate the underlying computer systems that support creative work" (Bogost and Montfort, 2009: 1). This approach addresses a gap in media studies work by acknowledging that, in addition to the content and interactions on social media, technical systems configure social behaviors in various, and sometimes hidden, ways.

Ultimately, then, in accordance with grounded theory, the processes of data collection and analysis were interrelated (Corbin and Strauss, 1990); as data were collected, information relating to the three emergent foci—topology, abstraction, and scale—were coded and categorized based on the canons and procedures of the grounded theory approach. The foci that emerged from earlier data of Mastodon federation were also incorporated into the next set of interviews and observation. We now turn to those three concepts.

Analysis

Mastodon challenges current conceptions of what "social media" means, specifically the implicit assumptions that (1) social media is logically and administratively centralized;

(2) social media only functions if its internal technical and organizational structures are hidden from end-users; and (3) social media's key metric of success is growth in terms of sheer numbers of users. We gloss each of these points in turn as *topology, abstraction*, and *scale*.

Topology

The first way that Mastodon restructures social interactions is through its unique network *topology*. Topology represents a network's logical shape or layout. The topological characteristics of a network are illustrated by how various nodes are connected. A common computer network is a centralized topology, where a central node controls all the other nodes in the network. Most popular social networking sites, such as Facebook and Twitter, use a centralized topology with all data flowing to and from the logical center. Social relations are constrained in a centralized topology. Not only do interactions cease to exist if the central hub goes down, but communities are bound to the rules, regulations, and structure of these CSM sites (Gillespie, 2018). In this way, centralized systems fully define and control the social engagement of their users.

In contrast to Facebook and Twitter, the data revealed that Mastodon's topology is federated, a special type of decentralized topology. Unlike the centralized topology, in which all users use a single service provider, in a federated network, "each resource provider maintains local autonomy, and the ability to set policy for use of its own resources," while enabling a larger network to be built out of connections across each resource (Berman et al., 2014: 17). Federated topology lowers the risk of entire network failure by having several key nodes instead of using one central node. In such systems, users connect to individual servers, which then communicate with one another across a larger network.

In the case of Mastodon, these individual servers are termed "instances." There is one flagship Mastodon server (instance), mastodon.social, and thousands of other instances that are structurally independent of one another. Instances are often founded on similar interests and ideologies (Rhodes, 2017), and administrators independently decide the language and behaviors allowed on their instance (Chenet, 2017). Much like email systems, the fact that a user signs up with one Mastodon instance does not mean the user cannot communicate with a user on a separate instance. As Mastodon developer, Eugen Rochko notes in a published interview, federation "means that users are spread throughout different, independent communities, yet remain unified in their ability to interact with each other" (Farokhmanesh, 2017a). For example, one of the authors has engaged in participant observation on an academic-oriented Mastodon instance, scholar.social, but regularly communicates with users on a range of other instances across what is termed the "Mastodon Fediverse."

Similarly, unlike centralized commercial social media platforms, distributed social networks such as Mastodon are independently managed. As we will discuss further in the "Abstraction" section, this enables each Mastodon instance to implement its own moderation and content rules while enabling individual members to communicate across the network. Like a federated political system, it is possible to speak of a unified whole (e.g., "Mastodon," "federation," or "the Fediverse") or to speak of specific Mastodon instances, which have their own rules and memberships.

Overall, federation is perhaps the single most apparent difference between Mastodon and CSM, such as Twitter. Federation allows us to expand our understanding of how technological design and social interactions merge on ASM sites. In this sense, Mastodon's decentralized structure helps shape the other key aspects we focus on, including abstraction and scale. We turn to them next.

Abstraction

Mastodon's approach to software *abstraction* is another way the site redefines what the "social" looks like on alternative networking platforms. In software engineering and computer science parlance, abstraction refers to hiding internal details, either from the system's end-users or from other developers (Kramer and Hazzan, 2006). Overall, software abstraction means that the internal details of any given software system—from hardware to data storage to the algorithms that sort content—are hidden, especially from end-users (Gehl, 2012).

As complex software systems, CSM are comprised of many abstractions that hide their internal workings. A common example is algorithms, specifically those that present content to users on Facebook or determine trending topics on Twitter (Bucher, 2018). Through the use of intellectual property regimes and topologies, CSM prevent end-users from knowing how these algorithms work. Instead, content or trends simply appear. This situation includes more than just the algorithms: end-users have little knowledge of details such as where their personal data are stored, how it is moved across the network, who has access to it, or what sort of conclusions can be drawn from it. End-users also have little to no control over the design and interfaces of CSM. CSM are software abstractions *par excellence.*

In contrast, the data revealed that many ASM, including Mastodon, are free and open-source software (FOSS) projects. Mastodon is licensed with the GNU Affero General Public License, meaning its code is open for inspection and free for anyone to modify. Mastodon is collaboratively developed using Github. Its documentation and policy statements are also collaboratively developed. Such licensing and development practices allow users to plumb Mastodon's abstractions, seeing—and even being able to modify—the internal details of interface design, networking algorithms, and software-to-hardware relationships.

As an example, consider an issue posted on Github, "Text Formatting" (Exagone313, 2017). The author of the issue, Exagone313, provided code that could enable text formatting in toots by using asterisks (e.g., surrounding text with "**" would make the text bold). The code was a suggested modification to previous code that handled the presentation of links and tags. In nearly 70 comments on Exagone313's original blog post, other developers weighed in on this possible change to the user interface. Some include more sections of code, others pointed to different aspects of Mastodon's code that could be adopted for this purpose. As of this writing, the issue is not settled, although consensus appears to be building about implementing Exagone313's idea into Mastodon itself. This example shows the stark difference in abstraction, and options for interaction, between Twitter and Mastodon. Although Twitter also evolved at the recommendation of its users (e.g., incorporating the verified icon for celebrities, developing a retweet button after

users starting reposting using "RT"), these adaptations were still developed by the core engineers of the site. Mastodon is fully developed by its users. This is not limited to coding, but also the development of icons, graphics, documentation, and policies.

As for algorithms, insofar as Mastodon uses algorithms, these are for moving data from instance to instance. They are not used for shaping the social streams individuals see (Soh, 2017). Instead, Mastodon's developers have created a variety of filters that the end-users themselves can use to sort content, including views for local timelines, global (across the federation) timelines, and feeds from whomever the user is following. Users can block or mute many types of toots from other individuals or entire instances or through keywords. There is nothing analogous to algorithm-created "In Case You Missed It" tweets or sponsored posts on Mastodon.

In addition to the technical aspects of a software system, software abstraction also overdetermines the forms of social organization that are shaped by software architectures (Gehl, 2012). Layers of opaque abstractions in software parallel layers of opaque organizational structures, such as large corporate bureaucracies. Mastodon's code is not the only place where end-users can see internal details; Mastodon instance administration is also far less abstracted. The administrators of instances offer contact information and participate in the instances they run. They post instance codes of conduct and negotiate disputes with users. For example, in an interview, wxcafé, the administrator of social.wxcafe.net, discussed their dispute resolution procedures in cases of toots that may violate that instance's Code of Conduct:

> Most of the time, I use my own judgment, and ask people what they meant and tell them to be clearer/not to express this kind of stuff next time. If they reiterate I give them a second warning, and if they reiterate again I give them 24h to get off the instance before I delete their account. Of course, intent plays a lot into it too, I don't just apply the rules blindly like a machine.

The other administrators we interviewed noted a similar combination of instance-specific codes of conduct and their own situation-by-situation style of resolving disputes and conflicts. In our review of the codes of conduct we collected in the Social Media Archives Project (S-MAP), we also noted a strong preference for case-by-case moderation.

This more distributed form of moderation further contrasts Mastodon with centralized systems, such as Twitter. Commercial social media rely on employees assigned the role of content moderators. To handle a large volume of information, commercial content moderation (CCM) is often utilized. CCM is "the large-scale screening by humans of content uploaded to social-media sites—Facebook, Instagram, Twitter, YouTube, and others" (Roberts, 2017: para. 5). Facebook is known for having a team of 7500 content moderation workers who make decisions about the appropriateness of the content, alongside the site's algorithms (Shah, 2017). However, even with a large number of content moderators, CSM often face controversy because they allow hate and offensive speech. Even though CSM are striving for more aggressive policy in recent years, Facebook is very literal in defining hate speech, which means that unless explicitly stated, posts expressing bias against a specific group often stay up (Tobin et al., 2017). Thus, users who confront such speech have little recourse other than to flag it and hope a moderator

reviews the content, agrees that it is hateful, and removes it. Moreover, in situations where end-users believe their accounts or posts were removed unfairly, as was recently the case for several conservative politicians, activists, and social media personalities (Coaston, 2019), users have to resort to complaint systems (i.e., another layer of abstraction) and hope their content is restored.

In contrast, on Mastodon, there is no single moderation policy. Instead, each Mastodon instance has its own moderation policy. Content moderators of Mastodon instances—typically the founding administrators—monitor content through a community-based moderation that is far less removed from end-users. Some instances are lightly moderated and have a rather liberal moderation policy, but others have more tightly regulated rules. For example, the (now defunct) instance freespeech.firedragonstudios.com was an example of the liberal, free speech absolutist variety. Its moderation policy was that "everyone should have the right to speak their mind without fear of being silenced" (Sietch, n.d.). In contrast, in an artifact collected in the S-MAP, the mastodon.social rules explicitly prohibit "Content illegal in Germany and/or France, such as holocaust denial or Nazi symbolism," "racism or advocation of racism," "sexism or advocation of sexism," "discrimination against gender and sexual minorities, or advocation thereof," and "xenophobic and/or violent nationalism" (Rochko, 2017: para. 1). Users who prefer a liberal moderation policy can gravitate to instances that emphasize free speech. Those who prefer instances that protect users from hate speech can join instances such as mastodon.social. Moreover, whenever users run afoul of moderation policies, they can directly contact their instance administrators and negotiate, as described above.

Much like the affordance of seeing the underlying code—which makes visible many layers of software abstraction—the ability to select an instance that comports with one's politics and talk directly with administrators helps remove layers of *social* or *organizational* abstraction that tend to appear in CSM. In doing so, Mastodon turns the site's technical development, platform design, and governance into social enterprises in and of themselves. This is *sociotechnical* to its core. Users join knowing they have the opportunity to be involved in establishing the parameters of the site. This unfettered access to Mastodon's software code or codes of conduct is a sharp departure from the CSM model where the internal workings—software or organizational—are revealed only through processes of speculation and analysis undertaken by journalists and academics.

Scale

Mastodon demonstrates how different *scaling* paradigms affect the type and quality of engagement on social media sites. Scale is a critical feature of CSM. In the CSM model, social and economic capital are inextricably linked to the number of participants. Once social media sites amass enough users, they then become valuable economic opportunities for external investing and advertising. For example, Facebook's (2018) Q2 earnings reports lead with revenues and the growth in "Daily Active Users" and "Monthly Active Users" as the most important indices of success. The economic value of large-scale social media platforms contributes to the capitalist emphasis of growth above all else, often to the detriment of other values, such as social development, meaningful interactions, safety, or the quality of political debate.

In contrast, the data revealed how scale looks vastly different in Mastodon's federated structure. Instead of growth of users en masse, which is typical for CSM, Mastodon users and administrators emphasize the number of instances in the Fediverse. Every instance we observed highlighted scale by listing the number of users, statuses or toots, and connections with other instances. This information signals an instance's level of engagement and activity so that potential users can join instances that align with their social needs. Understandably, instances require a certain number of active users for the continued success of Mastodon writ large, and instance moderators fully acknowledged the importance of scale in this regard. As the moderator of the awoo.space instance noted in an interview, "Having people on the platform means it's more likely other friends will come here." This opinion of scale is supported by user @mattcropp who suggested in a #federation toot that "recruiting people in groups rather than as individuals" is needed "to ensure minimum viable network effect" on Mastodon. However, beyond the necessity of growth for Mastodon's basic survival, federation emphasizes horizontal growth between instances, rather than growth within instances.

Specifically, when asked about the ideal size of their instances, none of the moderators interviewed for this project expressed a desire for their instance to exponentially grow. Instead, the scaling focus was mostly tied to the number of active participants—those who regularly engaged on the site—and the ability to manage the instance. In one example, Milan, moderator of social.tchncs.de, said in an interview that instance size had yet to become a concern because there were only 200 or so active connections that contributed to the instance's content. If the content feed became too "spammy," then he would consider controlling the size of the instance. In a similar example, Patrick Figel, moderator of mastodon.at, said in an interview that his ideal instance size was in the range of 500–1000 users, which again represented the number of users and amount of content he could reasonably manage to ensure the quality of engagement. Finally, in an interview, the social.wxcafe.net moderator did express a desire to increase the size of his artist-inspired instance (155 users at the time of interview), but only to the end of providing a greater platform for artists to share their work; growth, in this situation, was not about sheer size, but instead about promoting the work of a niche community.

Mastodon's focus on limited instance users to maintain quality interaction is further underscored by the common practice to close instance registration if and when they exceed the ideal, albeit arbitrary, number of users. This occurred in Mastodon's flagship instance, mastodon.social, after an influx in registration in April 2017 (Farokhmanesh, 2017b). We observed that Indhi Rousseau, moderator of mastodon.xyz, also closed his instance registration that same month for similar purposes. In fact, some instances, such as social.targaryen.house and mastodon.expert, include statements on their home page notifying users that registration is contingent on friendly experiences and instance performance. That is, instance moderators often retain the right to lock registration if their values and community are compromised.

While the instance moderators we interviewed appeared to be interested in keeping their Mastodon instances small in terms of number of users, they all expressed an interest in scaling the Fediverse itself to be as large as possible. Mastodon users expressed similar interest as well, as evident in @droxpopuli's toot:

> I don't mind if my stuff is seen across many instances but I'd love to see more from other instances . . . I just hope that followbots pick up good critical mass to make the federated timeline more of a global feel.

For this user, federation—rather than instance growth on its own—is desirable because it enables users to see both local and global content. The more instances that are created, the more options users have to connect to a global community of like-minded individuals. Herein lies one of the main benefits of scale on Mastodon: users can retain the communal nature of ASM (reflected in the smaller scale of individual instances) and still benefit from the size and networking of CSM (reflected in the size of the Fediverse itself).

The scaling dichotomies and opportunities on Mastodon—small instances but large Fediverse—demonstrate a trend away from the capitalist mentality that dominates popular CSM sites: growth above all else. Mastodon is able to facilitate intimate interactions between users while also enabling larger networks and greater connectivity. As awoo.net moderator Crom noted in an interview,

> Mastodon is a nice in-between mostly because it effectively gives you the ability to change that [identity and registration] based on the instance being run . . . there's nothing to stop you from solving those problems small-scale, which is great because then [you] have all these small-scale communities doing what each community wants.

Mastodon's approach to horizontal scaling also demonstrates a commitment to content variety that is not as visible on CSM sites. Since the goal of Mastodon is interest-based community engagement, and because there are no restrictions regarding who can create a Mastodon instance, users are encouraged to develop as many niche groups as possible. We observed this benefit of the Fediverse with instances such as a.weirder.earth for "thoughtful weirdos," rich.gop for friendly political debate, bookwitty.social for "dedicated book lovers," wandering.shop for science fiction and fantasy, scholar.social for academics, and many more. As more registrations close, new instances are developed, which simultaneously achieves the scaling concerns of Mastodon in addition to providing an interest-based space unique to ASM.

Moreover, federation and horizontal scaling have privacy implications. Because each instance runs independently, there are no central servers from which to glean information, unlike Twitter or Facebook. As the Fediverse grows, Mastodon does not become more valuable to profit-driven organizations because instances may or may not be connected in a manner useful to data mining. Advertising—and its attendant surveillance practices—is kept out of the Fediverse in favor of richer user experience and the continued use of the site.

The shift from scaling as an economic enterprise to scaling as an enhancement of user experience ultimately demonstrates the advantage of ASM over CSM: Mastodon is a liberated forum wherein users can freely express their interests and ideas decoupled from the "watchful eyes of corporations" (Srauy, 2015: 2). In fact, for user @ricardojmendez, Mastodon reflects a fundamental return to the Internet's roots as a "bunch of individuals running their own servers." As CSM continue to face challenges related to their centralized structure and unfettered growth (e.g., data mining, privacy

breaches, limited interaction), federation helps us rethink how scale—both limited and large—can restructure social engagement in service of the participants.

Discussion

Mastodon may never be a "Twitter Killer." After 4 years in existence, it is unlikely that Mastodon will draw enough users away from Twitter or amass enough of their own users to fully replace the corporate giant. As this article argues, this zero-sum approach to ASM evaluation is reductive because it fails to recognize the value of ASM in restructuring the foundations for online social interaction—what social interactions look like and who controls those experiences. Given this perspective, several points warrant discussion.

The components of topology, abstraction, and scale reveal a distinct type of sociality on ASM compared to CSM. First, sociality is more *negotiable* on ASM, in terms of both technosocial and sociocultural relations. Centralization eliminates social media users from technical and operational decision-making, leaving them little to no agency over platform adaptation. In the corporate model, users are prevented from even knowing the inner-workings of a site, let alone have an opportunity to be involved with its development. These fixed technosocial relations predetermine the sociocultural interactions on CSM. Without opportunities to adapt a site's infrastructure, and without information regarding content filtering, users are relegated to social interactions that are envisioned and restricted by the site's engineers. In contrast, federation, open abstractions, and horizontal scaling enable users to negotiate both platform and social configurations. How should communities be structured? What features and affordances should be coded? What icons and graphics should be used? How many users should a community permit? What content rules should be enforced? The answers to these questions vary on the users in each community. Due to topology, abstraction, and scale, sociality on ASM includes the negotiation of software affordances, community parameters, and user norms.

Moreover, open organizational abstraction (e.g., having moderator contact information, negotiating rules) and horizontal scaling lead to *monitorial* sociality on ASM. Because moderation policies result from processes of negotiation, users remain vigilant regarding the types of behaviors they deem (in)appropriate for an instance. Users in violation of an instance's expectations are managed at the communal level and, in some cases, through platform adaption (e.g., adopting new rules or features to prevent inappropriate posts). As an extension of technosocial negotiation, users are inadvertently conditioned and technologically enabled to monitor their own engagement and that of fellow users in line with the values of the community. This is a sharp departure from CSM where users have little corrective authority if they find the tenor of a post inappropriate. Sociality on ASM, then, includes processes of checks-and-balances that are enabled by open abstraction and small-scale communities.

Finally, the federation and scaling of ASM point to a shift from an individual-based to an *interest-based* sociality. CSM are positioned as tools for personal promotion, self-expression, and expanding social networks (Jenkins and Carpentier, 2013). Now that CSM sites like Instagram and YouTube enable users to financially profit from their participation, users have adopted and adapted attention-seeking behaviors (e.g., strategic timing of posts, filters, establishing a "brand," partnering with companies) to

establish online presences conducive to social and economic capital (Zulli, 2018). Instead, federation and the horizontal scaling of ASM emphasize interest-based sociality. In particular, Mastodon extends Twitter's topical/interest-oriented approach to the level of topology; users do not just "follow" their interests, they join instances largely based on their interests. Moderation policies are also determined with the instance's topical or value orientation in mind (e.g., resources to help students cheat are prohibited on scholar.social). In this ASM model, social interactions are centered around users' interests, not necessarily users themselves. This point is underscored by the common Mastodon practice of using pseudonyms as profile names. Although some users reveal their identity, posting professional affiliations and biographical information, some choose to remain anonymous, centering their identity and exchanges around their topical community. Collectively, then, topology, abstraction, and scale offer a unique ontological lens for considering sociality in online space. Instead of the corporate model where pre-existing technical structures determine social structures and platform capitalism often motivates network expansion, ASM users become social beings through processes of negotiation and interest-driven engagement.

In many respects, negotiable, monitorial, and interest-based sociality on ASM aligns with the original idealizations and addresses the current critiques of participatory culture (Fuchs, 2017; Jenkins, 2008). Although the Web 2.0 and sites like YouTube were once celebrated for enabling the production and consumption of grassroots media (see Jenkins, 2008), scholars eventually realized that "full" participation should include not just interactivity *through* media, but the "equal power positions of all actors in a decision-making process" *in* media, which CSM does not and cannot provide (Jenkins and Carpentier, 2013: 267; see also Pateman, 1970). Scholars now argue that a "participatory internet can only be found in those areas that resist corporate domination . . . where users engage in building and reproducing non-commercial, non-profit internet projects" (Fuchs, 2017: 75). Open-source projects like Mastodon are designed with these principles in mind and perhaps move us closer to realizing a full participatory culture vis-á-vis a reduction in abstraction.

However, when technosocial relations are collapsed, critiques about access inequalities preventing a full participatory culture come into sharp focus (see Carpentier, 2016; Jenkins and Carpentier, 2013). Topology, abstraction, and scale lead to greater access to the social networking process. Yet, greater access does not necessarily lead to ASM being more accessible to the general public. For example, there is little documentation and instruction on how to set up and moderate a Mastodon instance (Hogan, 2017). Instance development and moderation necessarily require a certain level of technical expertise. Because a baseline knowledge of federated systems and open protocols is needed to fully engage on ASM (users can still join Mastodon without contributing to instance development), Mastodon and other similar sites are perhaps more technologically elitist than their CSM competitors, which may discourage certain users who are intimidated by these aspects. Thus, this discussion of Mastodon as an alternative to CSM usefully expands our understandings of the "participatory intensities" that exist within the online social networking space (see Jenkins and Carpentier, 2013: 267). ASM facilitate participation for those looking for negotiable, monitorial, and interest-based sociality. CSM facilitate participation for those desiring effortless and individual-based

sociality. From this perspective, "participation" and the "social" in social media are best perceived as user-specific instead of an inherent quality or feature of digital technology.

Ultimately, the concepts that emerged from the study—topology, abstraction, and scale—have theoretical utility beyond this specific study. These concepts indicate an emergent social structure in the digital age where technology in and of itself becomes the basis for online sociality. These concepts also demonstrate how ASM facilitate participatory culture in unique ways. Moving forward, topology, abstraction, and scale can be taken up for subsequent analyses not only of Mastodon but also other, emergent ASM as well as established CSM. The concepts are especially powerful in a comparative approach, as was established in this essay. An example would be a comparison of the federated Mastodon with Reddit, a social news discussion site. While the two share some commonalities (especially in terms of moderation practices that vary according to instance or subreddit), they also diverge in their emphases on scale. Using these concepts as a theoretical framework could usefully nuance our understanding of ASM within these broad categories.

Although Mastodon ameliorates many of the concerns of CSM, it is important to note the potential challenges of Mastodon. In particular, the economic structure warrants critique. A main appeal of CSM is that they are free to users in exchange for their data and content. As discussed, Mastodon's horizontal structure prevents the scale needed to attract outside advertisers, a feature touted as an advantage of ASM. As a result, however, the labor and financial burden of Mastodon largely falls on each instance moderator (Henry, 2017). Considering the high market value of web development, moderators potentially forfeit huge amounts of profit facilitating the social networking experience for other people. In some cases, Mastodon users do compensate moderators for their work and contribute to the operating costs of an instance through crowdsourcing platforms such as Patreon (Valens, 2019). However, these volunteer contributions are certainly not the norm. Mastodon's economic structure inevitably raises questions about sustainability. Users may not be willing to financially support individual instances, and without that support, moderators may be less inclined or able to facilitate instances.

Another critique of Mastodon is its potential to enable echo-chambers in ways similar to CSM. An enduring concern of sites like Facebook and Twitter is the homophily of networks and information that results from selective exposure (see Colleoni et al., 2014). Although Mastodon's federated structure enables content variety, if instances do not connect with other instances or only choose to communicate with similar instances, echo-chambers may develop Mastodon as well. In fact, Mastodon may even enable content homophily to a greater extent than CSM. Recent research suggests that some features of CSM (e.g., trending topics, algorithms that promote posts with large engagement) incidentally expose users to opposing viewpoints (Flaxman et al., 2016). There are no overriding algorithms that guide Mastodon's content in this manner. If users want to avoid certain topics or issues, they are free to construct those boundaries. Similarly, federation might also become problematic if an instance permits extremist rhetoric or inappropriate content. For instance, Mastodon is currently grappling with the recent implementation of their open-source code by Gab, a far-right social media network with suspected terrorist ties (Makuch, 2019). Because Mastodon's free software license empowers any person or group to use their code, Gab, unfortunately, is within their right

to host a Mastodon instance. Although many instances have blocked Gab's domain, Mastodon administrators will need to consider how federation might encourage hate speech online and ways to manage those groups. Future scholars should also explore echo-chambers on Mastodon and the extent to which topology, abstraction, and scale facilitate problematic online behavior.

This study is not without limitations. One central limitation is the sample size and gender of instance moderators interviewed for this project. Only five self-identified male instance moderators agreed to participate in this study. Although smaller sample sizes are common in exploratory qualitative analyses, and we supplemented the sample by including user toots, participant observation, and blog posts, more work that includes a broader range of participant voices—including women's and non-gender-conforming voices—is needed. Another limitation is that this study was not able to compare Mastodon to other social configurations or include a nuanced examination of the interactions on Mastodon instances. This first examination necessarily focused on the features that distinguish the site from CSM to provide an alternative narrative to the "Killer Hype Cycle." A natural next step will be to extend research on content creation, curation, and moderation using topology, abstraction, and scale as a theoretical framework to compare Mastodon to other, similar social networking sites, such as Reddit or Tumblr (e.g., Massanari, 2017; Renninger, 2015). Future work should also interrogate the decision-making process for Mastodon moderators, how instance protocols/rules are developed, and the cultural interactions that follow. For now, this study makes a strong case that Mastodon is an innovative example of social networking and topology, abstraction, and scale provide a useful framework for future analyses seeking to understand how ASM expands our technosocial imaginary.

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Note

1. However, as fediverse.network's "About" page explains, its "data is far from perfect" and is likely undercounting the total users and instances (see https://fediverse.network/about).

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Appendix 1.

Interview questions

1. What have been your experiences with social media, from mainstream (e.g., Twitter) to alternatives (Mastodon or beyond)?
2. Prior to hosting a Mastodon instance, what experiences did you have with hosting Web sites or doing other technical things?
3. Why did you decide to administer/host a Mastodon instance?
4. How would you characterize the relationship between Mastodon and Twitter?
5. Twitter has traditionally been at 140 characters, though it is expanding its character limit to 280. Mastodon has always been 500 characters. How does this difference change the quality of interaction on Mastodon in comparison to Twitter?
6. How big do you want your instance to be? Is there an upper limit of users?
7. How big do you want the Fediverse to be?
8. What sort of users do you want on your instance?
9. What sort of users do you not want?
10. What has surprised you about Mastodon's culture and users?
11. As an administrator, how do you determine which toots are acceptable on your instance and which toots are not? And what do you do about toots that cross the line?
12. In many mastodon instances, the rules are very culturally or geographically specific. How do instance admins negotiate conflicts between their instance's culturally/geographically specific rules and users/admins of other instances who have different cultural rules and standards?
13. How would you explain federation to people who have only experienced centralized services?
14. How do you decide which other instances to federate with and which (if any) to silence or block?
15. Do you discuss the work of instance administration with other admins? If so, what are the biggest topics of concern?