Re-start social media, but how?

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A B S T R A C T

Social media has captured a large share of the public sphere at a pace far quicker than any other means of communication did in the past, but the initial techno-optimism that marked this ascent has recently started giving way to critical assessments of its wide-ranging effects. In this article, we argue that just as there is a need to assess and highlight its many ills, there is also an urgent need to foster and expand discussion on what a healthier version of social media could look like. We examine social media from the perspective of its three constituent parts, namely social networks, communication within these networks and the platforms that enable them. Subsequently, we argue that social media as an idea should be reimagined independently of the limited group of platforms that currently monopolize it. To that end, we discuss alternative models such as federated, blockchain-based and public-service social media platforms, and the measures required to ensure a level playing field for their emergence.

Social media, heralded in its infancy for giving a voice to the voiceless, for connecting the world as a whole, and as a multiplier for democracy and truth [1–4] is now derided by many for facilitating the spread of disinformation [5,6], acting as a tool for radicalization [7–9], hijacking user attention [10,11], and for using a business model built on invasion of user privacy [12,13]. There is thus an urgent need to foster and expand discussion on what a healthier version of social media could be [14]. Such a discussion has to start with an evaluation of social media's lofty initial promise that needs to be maximized and its recently uncovered harms that need to be minimized.

The promise of social media

There are manifest and clear benefits to using social media that accrue to individuals and society at large [15]. For individual users, social media can serve as a link to both local and international communities, improve their sense of connectedness, help them to build social capital and profit from the resources of their own social networks [1,4,16]. It can provide access and communication tools for cultural movements, advocacy groups, political parties, and even governments. See, for example, social media effects on Arab spring [17] or the umbrella movement in Hong Kong [18]. See Singer & Brooking [19] for a detailed discussion on the political power of social media and its impact on society. Additionally, social media can also be of help to disaster management and emergency services [20]. At the moment of writing, more than four bil-lion people use a social media service [21]. The sheer number of users and the countless hours being spent on these platforms [21,22] underline the notion that people find value in using social media.

A variety of psychological and sociological research has examined why people use social media. One prominent approach is the 'uses and gratification' theory. This theory finds its origin, among others, in Herta Herzog's observations on why people listened to radio shows in the 1940s [23] and was formalized later in the 1970s [24]. The key idea of uses and gratification theory is as follows: humans have basic needs which can be satisfied by technology use (gratification through technology use). It has been observed that using social media can result in gratification of basic social needs and also gratification of needs to self-promote own projects and so forth [25–27]. Several works have proposed varying lists of usage motives [27–29]. The gratification of social needs represents a powerful usage motive, because social media, at its best, allows meaningful communication between people and helps to establish social capital [2,4]. Establishing social capital helps users to have wider outreach on the social media platforms, which falls in line with another gratification/usage motive, namely using social media as a tool to experience utilitarian gratification likely linked to power motives [28].

Related ideas come from personality psychology: here, scientists have tried to understand if and to what extent certain personality traits are linked to using social media. For instance, it has been shown that social media users are a bit more extraverted than non-users [30–32],

and extraverted persons are also known to have higher needs for social interactions [33]. Thus, more extraverted individuals are likely to use social media to satisfy their need of having social interactions suggesting an overlap between theories from personality psychology and the uses and gratification theory [34]. In summary, it is clear that social media helps to build social capital [35] and offers a number of benefits to individuals [1,4], organizations [36,37] and social movements [2,3] that are worth preserving.

The blight in the business model

Social media has grown much too fast, and the initial techno-optimism has recently started giving way to critical assessments of its wide-ranging drawbacks. Much of this critique can be traced to monetization of surveillance capacities [13] as the prevalent business model underlying most social media companies. This model entails that users exchange their personal data for usage allowance of a platform. The data thus collected is used to predict manifold psycho-social characteristics on a fine granular level, which in turn is used for advertisements that gain in value by employing microtargeting and personalized persuasion [38,39]. For empirical insights into the effectiveness of psychological targeting see exemplary works by Matz et al. [40] and Zarouali et al. [39]. Monetization of the deep insights into the lives of social media users gained from their digital footprints has made tech-giants such as Meta (formerly known as Facebook) among the richest companies in the world. The platforms' vested interest in maximizing both the collection of a user's personal data and the display of advertisements has led over many years of AB-testing to highly immersive online-platforms designed to foster long online stays and high engagement on the part of the users [41].

The dark side of the data business model behind social media services has become apparent over time. For instance, design elements such as personalized news-feeds might not only lead to addictive use of social media services, but might also create political filter bubbles among some of the users [14], thus putatively narrowing the world view especially of those users who get news exclusively via social media [42]. This business model also pays little regard to widely treasured notions of privacy and abuses it as a matter of course [38,43]. Additionally, it has been observed that algorithms driving engagement can enrage people [11,44] and it is well known that fake news represents a tremendous problem on social media platforms [45,46]. Recent political ramifications such as the storming of the US-capitol in the aftermath of the last US presidential elections [47], where social media is known to have played an important role [48], have put the spread of fake news under even greater spotlight. Lastly, as social media is controlled by private corporations, independent researchers have only very limited or no access to data and algorithms that they require to study other dangerous tendencies in social media usage [49–51]

The only way forward seems to be to expand discussion on what a healthier and better version of social media could be. This could be aimed at pushing, through suggestion and legislation, the currently ascendant platforms to adopt better practices. At the same time, any such discussion also has to aim at the creation of a truly competitive environment that allows new startups trying out new ideas to flourish.

Uncoupling social media networks, communication and platforms

We find it helpful to examine social media from the perspective of its constituent parts, namely networks, communication that happens through those networks, and the platforms that enable them. *Social media networks* refer to the community of people linked together through online tools. *Social media communication* includes not only the messages exchanged between people but also the user-generated content and the engagement with this content by other users. *Social media platforms* refer broadly to the set of companies and tools that enable online social networks and communications. We use these three dimensions as they were found to be the most helpful in organizing the issues under discussion in this article. However, we consider this neither to be an exhaustive nor the only possible ontology of the various facets of social media. The larger point we wish to make is that examining social media as a whole often becomes a nebulous exercise and splitting the discussion into its constituent (interdependent but dissociable) parts provides a better vantage point on its myriad problems.

Social media networks *are small world networks, we need to limit the outreach!*

Social media platforms profess that their ultimate goal is to connect everyone together in a social network (with the aim to harvest a maximum of digital footprints) but there are some perils that may be intrinsic to connecting large groups of humans [52]. The graph that results from the "friendship connections" in social networks can be described as a "small world network" [53]. This leads to the effect that everybody is connected to everyone else with just a few steps and, importantly, some nodes (users) in the network come to have far more edges (connections) than the average user. But this also means that the whole network structure is dependent on these hyperconnected users with disproportionate number of edges, who are often also hyperactive, and are therefore central to the flow of communication [11]. Having such power over information flow is one reason why so many people want to become influencers and why hyper-active users are causing so much problems in social networks [11]. For instance, the spread of fake news has been attributed to only a few highly connected and hyper-active users [54]. In contrast to the early vision of web 2.0 that was aimed at allowing everybody to speak out, today only few have the power to be heard on social media.

While the content distributed on social media is very fluid and changes quickly, social networks are quite slow and stable. The friendship connections change over time but without any action by the user, the network of friends and followers will be the same today as they were yesterday. One solution to change the existing power structures that are monopolized by a few hyperactive users and to distribute the control over information flow across many users is to make the network more dynamic. This can, for example, be achieved by limiting the outreach (i.e., the number of edges/connections) a single user can have. To guarantee that everybody can still connect to everyone else, connections beyond this limit should be made dynamical – in the resulting constantly changing cascade networks, the sub-graphs could be reconnected.

Social media communication *is an echo-chamber, we need more diverse discussions!*

If we see social media from the perspective of flow of information, there are clear and well-studied negative effects that result from the way communication happens on social media [55,56]. Users can end up in interconnected echo chambers where they reinforce each other's pre-existing attitudes by seeing and discussing similar, attitude-aligning content over and over again [56]. Different opinions are presented but mostly filtered through partisan comments of other accounts from the same echo-chamber. Additionally, what goes "viral" in the end is the most simplistic version of any public opinion carefully tailored with emotional triggers [57]. Surely, sometimes virality caused by the recommendation systems can be desirable, e.g., when the best cat meme reaches everyone who is interested in cats. But such viral content is also competing with, and presumably reducing the outreach of all the other relevant content because it is put into one's 'personalized feed' or 'timeline'. In political settings, it has been shown that these dynamics can lead to polarization [56]. Social media communication, as curated by the major platforms, has thus become very similar to the rainbow press, transferring everything in simple and often scandalous messages. As a possible solution, instead of recommendation systems pushing viral content, social media communication could be explicitly tailored to

prioritize content for diverse interests differentiated by topics, regions and consciously chosen preferences. This could be done by including diversity as a necessity in recommendation algorithms and giving users better and meaningful control over what appears in their feed.

Social media platforms *are over-fitting recommendation systems, we need to change the optimization target!*

As discussed previously, many of the problems caused by social media platforms can be traced to their business model. The incentive to find out which advertisements fit to which user has meant that platforms try to maximize interaction at all costs. Social media platforms are using machine learning algorithms to predict which content will likely be "most relevant" for the user. But relevance here falls down to a simple metric: interaction. Social platforms count all the likes, shares, retweets etc. and try to match the content to the users in a way that the frequency of interaction is maximized – an approach coined "meaningful interaction". From the companies' perspective, this approach maximizes revenue – more interactions reveal more preferences of the user and also lead to more time to show advertising. From the user perspective, "meaningful interaction" seems to present content that might capture attention at first glance but is essentially shallow – fast reactions are encouraged over thoughtful replies; content that triggers the user seems to be highlighted. The final result of this "meaningful interaction" is, unnecessary and often negative, excitement, arousal, and commotion [55].

It is also important to note that the automated recommendation systems used by the social platforms are producing these results without any human intervention. Especially deep learning has been very efficient in finding complex patterns in content and users' meta-data that can be harvested without even understanding what the pattern is. Algorithms from the field of computer vision can label pictures and videos and find similarities. Big models like GPT-3 and BERT from the field of natural language processing are capable of revealing very subtle patterns in written or spoken content [58]. The better these algorithms work to trigger the users, the more obvious it becomes that these systems seem destined to follow a vicious cycle – they are trained on the interactions of the users that were already manipulated by the recommendation system [11]. This reinforcement loop makes these algorithms very efficient in maximizing user interaction in the interest of the platform's business model. Using a term from the machine learning community, social platforms are massively "over-fitting" the signal of users' preferences. Instead of focusing on the so-called "meaningful interaction", algorithms could instead be trained to present content that triggers "healthy behavior" [14] like long-reads, lasting friendships, and nontoxic debates.

Alternative approaches to social media

While the currently dominant platforms can and should reform themselves, it is doubtful whether a healthier social media could ever be built while keeping the structures and incentives under which their parent companies operate. A more effective alternative could be to emancipate the idea of social media from the currently prevailing companies, take a new path and look for alternative models of running and structuring social media networks and platforms. Below, we list some of the alternatives that incorporate a range of structural solutions for the problems of social media networks, communications and platforms.

Federated social networks

Federated Social Networks (FSNs; sometimes also referred to as Decentralized Online Social Networks, or DOSNs) are decentralized, open-source, ad-free, community owned online social media platforms that have emerged as the most favored alternative form of social media [59]. They differ from the prevailing social media platforms in multiple and meaningful ways [60–62]. Firstly, their decentralized nature does

away with dependency on any single, centralized entity. Secondly, they are based on open-source protocols and software which ensures transparency and gives a far wider range of developers the opportunity to innovate and try newer models and ideas. Importantly, the underlying code being open-source also means that algorithms that decide what appears in a user's feed are not secret and proprietary but open for anyone to examine. Thirdly, they tend to be crowdfunded and ad-free and hence are able to provide better control and ownership of personal data to the user and of creative content to the creator. Fourthly, they tend to be community owned and put the responsibility of operation and content moderation on the community of users.

A range of standards, software and services have been developed to facilitate FSNs. Fediverse refers to the ensemble of interconnected servers and services used for social media, microblogging, and other web activities [63]. These services, while independently hosted, can communicate with each other using open standards and protocols. The dominant open standard used in the Fediverse is ActivityPub [64], which is the official W3C (World Wide Web Consortium) recommended protocol for decentralized social networking. It provides a client to server API for creating, updating and deleting content, as well as a federated server to server API for delivering notifications and content [64].

Arguably the best iteration of FSNs that implement ActivityPub is Mastodon [62,63], which is an open-source decentralized social media platform. Importantly, Mastodon doesn't function as a single web entity but instead as interoperable code deployed across multiple websites. Developers are free to create and run their own server of their own version (referred to as an 'instance') of Mastodon. Every *instance* is owned, operated and moderated by the people that created it. Most *instances* tend to be crowdfunded, ad-free and community-owned. A user can create and store their account on any of the *instances,* and still freely communicate with users of other independently-owned instances. How decentralization affects the emergent dynamics of the social network has only recently become an active subject of research. It has been shown, for instance in the case of Mastodon, that this federated nature gives a unique structure to the resulting social network and the social interactions that follow [61,62].

Web 3.0 and blockchain based social networks

A federated approach to internet is not novel. The first iteration of internet, termed Web 1.0, was an entirely decentralized affair — an interconnected multitude of computers and servers that could communicate with each other using various open protocols and standards without the need for centralized and walled structures. However, interaction between the static, read-only webpages of Web 1.0 was mostly limited to hyperlinking. Web 2.0, the next and current iteration, enabled users to interact with and produce content for the web, which in turn enabled activities such as online shopping and social media. However, much of Web 2.0 has come to be captured by centralized walled gardens such as Meta, Google, Amazon and Netflix [21] with their control and management vested in a small group of people whose only incentive is the maximization of shareholder profits.

The problem remains as to how the affairs of an internet service be managed and decisions taken without appointing private companies or any centralized group of humans as the 'custodians of truth'. Web 3.0 (or Web3), the proposed third iteration of the internet, suggests a powerful alternative for control and management of internet services with the use of blockchain and cryptographic technologies [65]. The technology behind blockchain and cryptocurrencies relies on a decentralized network of computers that can validate and record transactions without human judgement or oversight by a centralized intermediary. This can be built into internet services to enable them to function in a trustless (without the need of a trusted intermediary) and permissionless (without the need of a controlling governing body) manner [66,67].

A social media platform can be built as a decentralized app (termed a DApp) based on a blockchain system [68]. While the associated soft-

ware can provide typical social media functionalities, the control of the DApp can be automated through smart contracts pre-written into the blockchain. For instance, such a DApp might issue tokens that represent ownership to the actual users of the system in accordance with their participation and adherence to the pre-written rules of the system. It suggests a model for a truly decentralized platform that runs without human intervention or control by any single entity and puts user sovereignty and transparency as its primary goals [67].

Steemit [69] offers a partial example of what a Web 3.0 social media platform looks like in practice. It is a decentralized app (or a DApp) for social media and blogging based on the Steem blockchain, and uses the STEEM cryptocurrency to reward users for their activity and the content they generate. Upvotes given by the community of users to a specific media post decide the payout of those posts. Steemit's 'curation rewards' (rewarding users for finding relevant content that gets upvoted by others) also offers a promising option for decentralized community moderation.

The other major impact of blockchain in the social media domain is likely to be for authentication of the original creator of a digital good [70,71], whether that's a text, an image or a video. Automated contracts (such as Non-Fungible Tokens) attached to a digital good that do not require any central authority to approve their terms and execution, have emerged as a unique form of digital rights management [70]. Pre-agreed rules can be written into the contract for a digital good which can then move freely between various social networks or streaming sites, while, for instance, the original content-creator gets compensated for every sale or reuse.

Similarly, Web 3.0 offers new solutions for authentication of users and the verification of the origin of a specific social media post which becomes all the more important in an idealized future where users and their posts move freely between various decentralized social media platforms [65,70,71]. This would further aid FSNs because the means through which a social media post was received can be separated from the capacity to check the veracity of its origin.

Public service social networks

Social media platforms remain free for the users, but as the internet truism goes, "if it's free, you are the product". Much as the monetization of surveillance is not desirable [13], money and resources required needed for running social media platforms have to come from somewhere. Alternative payment models are hence an important part of any discussion to restart social media. WhatsApp, in its initial years, offered a fair and exemplary monetary model. It was free for the first year, with a quite minimal $0.99 fee charged once every subsequent year. The company neither showed advertisements, nor sold data to private interests. The fee was fair and affordable for users and sustainable for the company. But soon after the company was acquired by Meta in 2014, this model was predictably discontinued. At the same time, there are downsides to alternatives that require direct payment by users. It remains unclear, now that users are used to social media platforms being 'free', how many would be willing to pay directly with their own money [72,73] and how many would rather keep paying with their personal data. It does not seem desirable to split the public into those who can afford digital privacy and those who can't.

One possible solution might be to expand the definition of public service media to include social media [74,75]. If social media can rightfully be seen as a public utility essential to democratic functioning, it stands well within the stated objectives and mandates of public service broadcasting laws in most liberal democracies [74]. Public broadcasters are funded in a variety of ways, which allow them to work solely for public service, from an obligatory television license fee, individual contributions, government funding and limited advertising. As discussed earlier, many of the problems associated with social media arise from the business model of maximizing engagement and selling surveillance to advertisers. A public digital social network would not have many of the problems of private social media companies simply by the virtue of not having their business model – no advertisers to maximize engagement for and sell data to, and no investors pushing for growth at any cost.

Ensuring a level playing field for new services

In practice, realization of any idea for restarting social media would first require a well-functioning marketplace of ideas that ensures that new services are given a fair chance in their competition with the established players. However, as things stand, the idea of social media has been captured by a handful of monopolies, which renders the larger landscape hostile to emergence of new iterations of what social media could be. There is an urgent need to weaken monopolistic network effects and data silos enjoyed by existing platforms. A number of concrete pathways exist to achieve this.

Breaking up the monopolies

In the United States, in late 2020, the Federal Trade Commission and 46 state attorney generals launched an antitrust lawsuit against Meta seeking to break up the monopolistic conglomerate by forcing the company to divest from Instagram and WhatsApp [76]. It is, however, expected to take a long time to come to fruition. Besides, breaking up the monopoly in this case would do little to solve the problem of data silos and network reinforcement effects as each of the separating entities (Facebook, Whatsapp, Instagram) is already large enough on its own.

Setting free the flow of users and data

The more potent way out might be to emancipate the idea of social media – as a dialogic media form that allows people to gather online for shared interests – from social media companies (Facebook, Twitter, etc.) by breaking the walled gardens of private platforms and encouraging data and users to flow between different platforms [77]. This can be done by requiring data portability, platform interoperability and delegatability, which in turn would ensure a level-playing field for newer services and a wider range of choices for users.

Data portability refers to the right of users to take their social identity and the social content they created and move it to a competing network. This lowers the cost of switching platforms as the users don't have to start from scratch on a new network [78].

Platform interoperability, as defined by the UK Competition and Markets Authority (CMA) is "the ability of platforms to exchange data and different forms of functionality across their services." Put simply, it aims to open up live exchange of information across platforms by requiring a dominant platform to let users of a competing startup to interact with its own users and services, and share content across both networks [77]. In practical terms, most existing social networks share a core set of features which might differ in branding but are essentially the same. The platforms could be required by regulators to maintain this core set of features in commonly-agreed standard formats that would work on any platform allowing user-generated content to move across platforms as per the wish of the user [79,77].

Delegatability refers to the ability of users to use a third-party custodial service to manage their privacy settings, content, and online interactions across multiple platforms [80].

The initial steps in this direction have already been taken in many countries. The ACCESS (Augmenting Compatibility and Competition by Enabling Service Switching) act, a bill introduced by a bipartisan group of senators in the United States Senate, takes several important steps towards portability, interoperability and delegatability [81]. The legislation directs public bodies (such as the Federal Trade Commission and the National Institute of Standards and Technology) to establish regulations for verifying user portability and interoperability and publish model technical standards to achieve them.

None of these suggestions is without precedence in the realm of communication and its regulation. Before the very recent fragmentation of internet into a few big companies, it was historically the norm in communication. For example, a Yahoo mail user is able to send emails to a Google mail user, a T-Mobile user is able to place a phone call or send an SMS to a Vodafone user. Or, for example, governments across the world require Telecom operators to provide mobile number portability, the ability to take your phone number with you when changing providers. There's little reason why the concept of free flow of information and fair competition should not be extended to social media [79,77].

Reimagining social media

It would be futile, if not vain, to want to imagine a simpler world without social media. Social media and its platforms remain immensely popular, have daily users in the hundreds of millions who seem to be getting more and more hooked and not less [21]. Not to mention that social media remains an intriguing, fast evolving and meaningful mode of communication that helps people connect to each other, at both personal [1] and professional [36] levels, and create social capital [4].

One way forward is to push, through suggestion and legislation, the existing platforms to reform and adopt healthier design principles guided by interdisciplinary research [57,82] and as discussed here. While many of the problems associated with social media could possibly be solved by such reforms, it is doubtful whether any meaningful change would actually come while keeping the business model (ad-driven surveillance capitalism) and incentives (maximizing interaction) under which the existing platforms operate [13]. The argument is not that these platforms cannot make these changes, but that they likely will not. Hence, reform of existing networks, while possible, is not a reliable solution.

The other way forward would be to adopt the principle of 'letting a hundred flowers bloom', and facilitating the emergence of multiple new models of what social media could be [59]. This would allow the exploration of a much larger solution space and hasten its optimization for public good. We discussed several alternative approaches to social media that offer a range of solutions to existing problems:

First, existing social media networks provide frictionless reach to every user resulting in power structures that get monopolized by a few hyperactive users [11]. Decentralized or Federated Social Networks (FSNs), on the other hand, are envisioned as a collection of multiple interoperable networks with each network using different recommendation algorithms and governing policies [60–62]. While their interoperability guarantees that everyone can still connect to everyone else, their decentralized structure, with each network using its own governing policy and differently incentivized recommendation algorithms, would limit the outreach any single user can have. This would add some necessary friction to the network and offer a natural defense against hyper-centralization.

Second, social media communication, as it is structured today, happens, in part, in interconnected echo chambers that can contribute to polarization in democratic societies [56,57]. A significant presence of a public service social network within a collection of FSNs would incentivize social media communication and content along ethical principles discerned by a public authority such as including diversity as a necessity. In a number of countries, legal frameworks already exist for traditional news media that are aimed at enhancing media plurality and to limit media concentration [83,84]. A public service network could, in principle, function along similar lines and be structured to ensure diversity of ideas and opinions within itself and similarly influence other forms of interconnected and interoperable social networks.

Third, social media platforms earn profits by showing personalized advertisements and this business model comes with a range of inherent problems such as the need to maximize user interaction at all costs [13,55,82]. In contrast, FSNs tend to be community owned and ad-free [61,62], and public service social networks [74,75] would rely on public funds such as the broadcast fee. They can thus avoid many of the problems of existing platforms simply by the virtue of not sharing the ad-financed business model. Moreover, their recommendation algorithms are open-source and transparent for anyone to inspect [61] and preclude optimization for hidden and unstated commercial motives.

The ideal scenario for the future of social media that we envision is a diverse collection of networks (Privately owned, Federated, Blockchain based, Public Service networks) that are interconnected and interoperable. In such a scenario, a significant portion of the landscape will be public or community-owned and will optimize itself solely for public good and would broadly influence the whole landscape towards adopting better standards.

We believe that the current models and problems of social media are path-dependent (i.e., the current outcomes have resulted from having followed a specific path of previous outcomes and incentives) and are neither inevitable nor the only models available. Social media remains a relatively new phenomenon of which only a few possible iterations have hitherto been tried and tested. Legislative, academic, and community driven efforts to ensure that alternatives can emerge and thrive can help social media fulfill its promise as a medium of communication that not only connects everyone together but one that also brings everyone together.

Declaration of Competing Interest

Dr. Montag reports no conflict of interest. However, for reasons of transparency Dr. Montag mentions that he has received (to Ulm University and earlier University of Bonn) grants from agencies such as the German Research Foundation (DFG). Dr. Montag has performed grant reviews for several agencies; has edited journal sections and articles; has given academic lectures in clinical or scientific venues or companies; and has generated books or book chapters for publishers of mental health texts. For some of these activities he received royalties, but never from gaming or social media companies. Dr. Montag mentions that he was part of a discussion circle (Digitalität und Verantwortung: https://about.fb.com/de/news/h/gespraechskreis-digitalitaet-und-verantwortung/) debating ethical questions linked to social media, digitalization and society/democracy at Facebook. In this context, he received no salary for his activities. Finally, he mentions that he currently functions as independent scientist on the scientific advisory board of the Nymphenburg group (Munich, Germany). This activity is financially compensated. Moreover, he is on the scientific advisory board of Applied Cognition (Redwood, CA, USA), an activity which is also compensated.

References

[1] K. Gillespie-Smith, G. Hendry, N. Anduuru, T. Laird, C. Ballantyne, Using social media to be 'social': perceptions of social media benefits and risk by autistic young people, and parents, Res. Dev. Disabil. 118 (2021) 104081, doi:10.1016/j.ridd.2021.104081.

[2] H. Hwang, K.-O. Kim, Social media as a tool for social movements: the effect of social media use and social capital on intention to participate in social movements, Int. J. Consum. Stud. 39 (5) (2015) 478–488, doi:10.1111/ijcs.12221.

[3] D. Kidd, K. McIntosh, Social Media and Social Movements, Sociol. Compass 10 (9) (2016) 785–794, doi:10.1111/soc4.12399.

[4] J.L. Pouwels, L. Keijsers, C. Odgers, Who benefits most from using social media, the socially rich or the socially poor? Curr. Opin. Psychol. 47 (2022) 101351, doi:10.1016/j.copsyc.2022.101351.

[5] J.C.M. Serrano, O. Papakyriakopoulos, S. Hegelich, NLP-based feature extraction for the detection of COVID-19 misinformation videos on Youtube, in: Proceedings of the 1st Workshop on NLP for COVID-19 at ACL 2020, 2020.

[6] K. Shu, A. Bhattacharjee, F. Alatawi, T.H. Nazer, K. Ding, M. Karami, H. Liu, Combating disinformation in a social media age, WIREs Data Mining Knowledge Discovery 10 (6) (2020) e1385, doi:10.1002/widm.1385.

[7] G.F. Hollewell, N. Longpré, Radicalization in the Social Media Era: understanding the Relationship between Self-Radicalization and the Internet, Int J (2021) 0306624X211028771, doi:10.1177/0306624X211028771.

[8] M. Shahrezaye, O. Papakyriakopoulos, J.C.M. Serrano, S. Hegelich, Measuring the ease of communication in bipartite social endorsement networks: a proxy to study the dynamics of political polarization, in: Proceedings of the 10th International Conference on Social Media and Society, ACM, 2019, pp. 158–165.

[9] R. Thompson, Radicalization and the use of social media, J. Strat. Secur. 4 (4) (2011) 167–190 https://www.jstor.org/stable/26463917.

[10] V.R. Bhargava, M. Velasquez, Ethics of the attention economy: the problem of social media addiction, Bus. Ethics Quarterly 31 (3) (2021) 321–359, doi:10.1017/beq.2020.32.

[11] O. Papakyriakopoulos, J.C.M. Serrano, S. Hegelich, Political communication on social media: a tale of hyperactive users and bias in recommender systems, Online Social Networks Media 15 (2020) 100058.

[12] S. Trepte, The social media privacy model: privacy and communication in the light of social media affordances, Commun. Theory 31 (4) (2021) 549–570, doi:10.1093/ct/qtz035.

[13] S. Zuboff, The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power: Barack Obama's Books of 2019, Profile Books, 2019.

[14] C. Montag, S. Hegelich, Understanding detrimental aspects of social media use: will the real culprits please stand up? Front. Sociol. 5 (2020), doi:10.3389/fsoc.2020.599270.

[15] E. Kross, P. Verduyn, G. Sheppes, C.K. Costello, J. Jonides, O. Ybarra, Social media and well-being: pitfalls, progress, and next steps, Trends Cogn. Sci. (Regul. Ed.) 25 (1) (2021) 55–66, doi:10.1016/j.tics.2020.10.005.

[16] T. Ryan, K.A. Allen, D.L. Gray, D.M. McInerney, How social are social media? A review of online social behaviour and connectedness, J. Relations. Res. 8 (2017), doi:10.1017/jrr.2017.13.

[17] C.A. Frangonikolopoulos, I. Chapsos, Explaining the role and the impact of the social media in the Arab Spring, Global Media J. 7 (2) (2012).

[18] E. Lee, Space of disobedience: a visual document of the Umbrella Movement in Hong Kong, Inter-Asia Cult. Stud. 16 (3) (2015) 367–379.

[19] P.W. Singer, E.T. Brooking, LikeWar: The weaponization of Social Media, Eamon Dolan Books, 2018.

[20] A.M. Mehta, A. Bruns, J. Newton, Trust, but verify: social media models for disaster management, Disasters 41 (3) (2017) 549–565.

[21] Kemp, S. (2021). Digital 2021: global Overview Report. https://datareportal.com/reports/digital-2021-global-overview-report.

[22] B. Auxier, M. Anderson, Social media in 2021, Pew Res. Center (2021).

[23] H. Herzog, Radio and Television: radio—The first post-war year, Public Opin. Q. 10 (3) (1946) 297–313, doi:10.1093/poq/10.3.297.

[24] E. Katz, J.G. Blumler, M. Gurevitch, Uses and gratifications research, Public Opin. Q. 37 (4) (1973) 509–523 https://www.jstor.org/stable/2747854.

[25] Froget, J.R.L., Baghestan, A.G., & Asfaranjan, Y.S. (2013). A Uses and Gratification Perspective on Social Media Usage and Online Marketing. 13.

[26] C. Gan, W. Wang, Uses and gratifications of social media: a comparison of microblog and WeChat, J. Syst. Inf. Technol. 17 (4) (2015) 351–363, doi:10.1108/JSIT-06-2015-0052.

[27] B. Schivinski, M. Brzozowska-Woś, E. Stansbury, J. Satel, C. Montag, H.M. Pontes, Exploring the role of social media use motives, psychological well-being, self-esteem, and affect in problematic social media use, Front. Psychol. 11 (2020) 617140, doi:10.3389/fpsyg.2020.617140.

[28] R. Sariyska, B. Lachmann, C. Cheng, A. Gnisci, I. Sergi, A. Pace, K. Kaliszewska-Czeremska, S. Laconi, S. Zhong, D. Toraman, M. Geiger, C. Montag, The motivation for Facebook use – is it a matter of bonding or control over others? J. Individ. Differ. 40 (1) (2018) 26–35, doi:10.1027/1614-0001/a000273.

[29] A. Whiting, D. Williams, Why people use social media: a uses and gratifications approach, Qual. Market Res. 16 (4) (2013) 362–369, doi:10.1108/QMR-06-2013-0041.

[30] J. Brailovskaia, J. Margraf, Comparing facebook users and facebook non-users: relationship between personality traits and mental health variables – an exploratory study, PLoS One 11 (12) (2016) e0166999, doi:10.1371/journal.pone.0166999.

[31] D. Marengo, C. Sindermann, J.D. Elhai, C. Montag, One social media company to rule them all: associations between use of facebook-owned social media platforms, sociodemographic characteristics, and the big five personality traits, Front. Psychol. 11 (2020), doi:10.3389/fpsyg.2020.00936.

[32] C. Sindermann, É. Duke, C. Montag, Personality associations with Facebook use and tendencies towards Facebook use disorder, Addict. Behav. Rep. (2020) 100264, doi:10.1016/j.abrep.2020.100264.

[33] L.D. Smillie, Extraversion and Reward Processing, Curr. Dir. Psychol. Sci. 22 (3) (2013) 167–172, doi:10.1177/0963721412470133.

[34] K. Kircaburun, S. Alhabash, Ş.B. Tosuntaş, M.D. Griffiths, Uses and gratifications of problematic social media use among university students: a simultaneous examination of the big five of personality traits, social media platforms, and social media use motives, Int. J. Ment. Health Addict. 18 (3) (2020) 525–547, doi:10.1007/s11469-018-9940-6.

[35] H. Gil de Zúñiga, N. Jung, S. Valenzuela, Social media use for news and individuals' social capital, civic engagement and political participation, J. Comput. Mediat. Commun. 17 (3) (2012) 319–336, doi:10.1111/j.1083-6101.2012.01574.x.

[36] L. Razmerita, K. Kirchner, T. Nabeth, Social media in organizations: leveraging personal and collective knowledge processes, J. Organiz. Comput. Electronic Commerce 24 (1) (2014) 74–93, doi:10.1080/10919392.2014.866504.

[37] F.P. Tajudeen, N.I. Jaafar, S. Ainin, Understanding the impact of social media usage among organizations, Inf. Manag. 55 (3) (2018) 308–321, doi:10.1016/j.im.2017.08.004.

[38] S. Dhawan, S. Hegelich, From outside in: profiling, persuasion and political opinion in the age of big data, in: C. Montag, H. Baumeister (Eds.), Digital Phenotyping and Mobile Sensing: New Developments in Psychoinformatics, Springer International Publishing, 2023, pp. 151–169, doi:10.1007/978-3-030-98546-2_10.

[39] B. Zarouali, T. Dobber, G. Pauw, C. Vreese, Using a personality-profiling algorithm to investigate political microtargeting: assessing the persuasion effects of personality-tailored ads on social media, Communic. Res. (2020), doi:10.1177/0093650220961965.

[40] S.C. Matz, M. Kosinski, G. Nave, D.J. Stillwell, Psychological targeting as an effective approach to digital mass persuasion, Proc. Natl. Acad. Sci. U.S.A. 114 (48) (2017) 12714–12719, doi:10.1073/pnas.1710966114.

[41] C. Montag, B. Lachmann, M. Herrlich, K. Zweig, Addictive features of social media/messenger platforms and freemium games against the background of psychological and economic theories, Int. J. Environ. Res. 16 (14) (2019) 2612, doi:10.3390/ijerph16142612.

[42] C. Sindermann, A. Cooper, C. Montag, A short review on susceptibility to falling for fake political news, Curr. Opin. Psychol. 36 (2020) 44–48, doi:10.1016/j.copsyc.2020.03.014.

[43] S.C. Matz, R.E. Appel, M. Kosinski, Privacy in the age of psychological targeting, Curr. Opin. Psychol. 31 (2020) 116–121, doi:10.1016/j.copsyc.2019.08.010.

[44] Chuai, Y., & Zhao, J. (2020). Anger makes fake news viral online. arXiv:2004.10399.

[45] D.M. Lazer, M.A. Baum, Y. Benkler, A.J. Berinsky, K.M. Greenhill, F. Menczer, M.J. Metzger, B. Nyhan, G. Pennycook, D. Rothschild, The science of fake news, Science 359 (6380) (2018) 1094–1096.

[46] G. Pennycook, D.G. Rand, The Psychology of Fake News, Trends Cogn. Sci. (Regul. Ed.) 25 (5) (2021) 388–402, doi:10.1016/j.tics.2021.02.007.

[47] A.H. Kydd, Decline, radicalization and the attack on the US Capitol, Violence 2 (1) (2021) 3–23, doi:10.1177/26330024211010043.

[48] Frenkel, S. (2021, January 6). How The Storming of Capitol Hill Was Organized on Social Media. The New York Times. https://www.nytimes.com/2021/01/06/us/politics/protesters-storm-capitol-hill-building.html.

[49] A. Bruns, After the 'APIcalypse': social media platforms and their fight against critical scholarly research, Inf., Commun. Soc. 22 (11) (2019) 1544–1566, doi:10.1080/1369118X.2019.1637447.

[50] S. Dhawan, S. Hegelich, R for Social Media Analysis, in: L. Sloan, A. Quan-Haase (Eds.), The SAGE Handbook of Social Media Research Methods, SAGE Publications Ltd, 2022.

[51] S. Hegelich, Facebook needs to share more with researchers, Nature 579 (7800) (2020) 473.

[52] C. Bail, Breaking the social media prism: how to make our platforms less polarizing, Breaking the Social Media Prism, Princeton University Press, 2021, doi:10.1515/9780691216508.

[53] D.J. Watts, S.H. Strogatz, Collective dynamics of 'small-world' networks, Nature 393 (6684) (1998) 440–442.

[54] N. Grinberg, K. Joseph, L. Friedland, B. Swire-Thompson, D. Lazer, Fake news on Twitter during the 2016 U.S. presidential election, Science 363 (6425) (2019) 374–378, doi:10.1126/science.aau2706.

[55] J.B. Bayer, P. Triệu, N.B. Ellison, Social media elements, ecologies, and effects, Annu. Rev. Psychol. 71 (2020) 471–497.

[56] J.J. Van Bavel, S. Rathje, E. Harris, C. Robertson, A. Sternisko, How social media shapes polarization, Trends Cogn. Sci. (Regul. Ed.) 25 (11) (2021) 913–916, doi:10.1016/j.tics.2021.07.013.

[57] N. Persily, J.A. Tucker, Social Media and Democracy: The State of the Field, Prospects for Reform, Cambridge University Press, 2020.

[58] Devlin, J., Chang, M.W., Lee, K., & Toutanova, K. (2018). Bert: pre-training of deep bidirectional transformers for language understanding. arXiv:1810.04805.

[59] S.R. Chowdhury, A.R. Roy, M. Shaikh, K. Daudjee, A taxonomy of decentralized online social networks, Peer Peer Netw. Appl. 8 (3) (2015) 367–383, doi:10.1007/s12083-014-0258-2.

[60] D. Koll, J. Li, X. Fu, The good left undone: advances and challenges in decentralizing online social networks, Comput. Commun. 108 (2017) 36–51, doi:10.1016/j.comcom.2017.04.008.

[61] M. Zignani, C. Quadri, S. Gaito, H. Cherifi, G.P. Rossi, The footprints of a "mastodon": how a decentralized architecture influences online social relationships, in: IEEE INFOCOM 2019 - IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS), 2019, pp. 472–477, doi:10.1109/INFCOMW.2019.8845221.

[62] D. Zulli, M. Liu, R. Gehl, Rethinking the "social" in "social media": insights into topology, abstraction, and scale on the Mastodon social network, New Media Soc. 22 (7) (2020) 1188–1205, doi:10.1177/1461444820912533.

[63] L. La Cava, S. Greco, A Tagarelli, Understanding the growth of the Fediverse through the lens of Mastodon, Applied Network Sci. 6 (1) (2021) 64, doi:10.1007/s41109-021-00392-5.

[64] Webber Lemmer, C., Tallon, J., Shepherd, E., Guy, A., & Prodromou, E. (2018). ActivityPub—W3C Recommendation 23 January 2018. https://www.w3.org/TR/activitypub/.

[65] P. Freni, E. Ferro, G. Ceci, Fixing social media with the blockchain, in: Proceedings of the 6th EAI International Conference on Smart Objects and Technologies for Social Good, 2020, pp. 175–180, doi:10.1145/3411170.3411246.

[66] B. Guidi, When Blockchain meets Online Social Networks, Pervasive Mob. Comput. 62 (2020) 101131, doi:10.1016/j.pmcj.2020.101131.

[67] C. Udokwu, H. Anyanka, A. Norta, Evaluation of approaches for designing and developing decentralized applications on blockchain, in: Proceedings of the 2020 4th International Conference on Algorithms, Computing and Systems, 2020, pp. 55–62, doi:10.1145/3423390.3426724.

[68] S. Raval, Decentralized Applications: Harnessing Bitcoin's Blockchain Technology, O'Reilly Media, Inc, 2016.

[69] C. Li, B. Palanisamy, Incentivized blockchain-based social media platforms: a case study of steemit, in: Proceedings of the 10th ACM Conference on Web Science, 2019, pp. 145–154, doi:10.1145/3292522.3326041.

[70] J. Fairfield, Tokenized: the law of non-fungible tokens and unique digital property (SSRN Scholarly Paper ID 3821102), Soc. Sci. Res. Network (2021) https://papers.ssrn.com/abstract=3821102.

[71] Y. Liu, D. He, M.S. Obaidat, N. Kumar, M.K. Khan, K.-.K. Raymond Choo, Blockchain-based identity management systems: a review, J. Netw. Comput. Appl. 166 (2020) 102731, doi:10.1016/j.jnca.2020.102731.

[72] C. Sindermann, D.J. Kuss, M.A. Throuvala, M.D. Griffiths, C. Montag, Should we pay for our social media/messenger applications? Preliminary data on the acceptance of an alternative to the current prevailing data business model, Front. Psychol. 11 (2020), doi:10.3389/fpsyg.2020.01415.

[73] C. Sindermann, H. Yang, S. Yang, J.D. Elhai, C. Montag, Willingness to accept (WTA), willingness to pay (WTP), and the WTA/WTP disparity in Chinese social media platforms: descriptive statistics and associations with personality and social media use, Acta Psychol. (Amst) 223 (2022) 103462, doi:10.1016/j.actpsy.2021.103462.

[74] C. Fuchs, Social media and the public sphere, TripleC 12 (1) (2014) 57–101, doi:10.31269/triplec.v12i1.552.

[75] J. van Dijck, T. Poell, Making public television social? Public service broadcasting and the challenges of social media, Television New Media 16 (2) (2015) 148–164, doi:10.1177/1527476414527136.

[76] FTC v. Facebook, Inc., (December 9, 2020). http://www.ftc.gov/legal-library/browse/cases-proceedings/191-0134-facebook-inc-ftc-v.

[77] Tapiador, A., & Hassan, S. (2018). Understanding Federation: an Analytical Framework for the Interoperability of Social Networking Sites. arXiv:1805.06474.

[78] B. Engels, Data portability among online platforms, Internet Policy Review 5 (2) (2016) https://policyreview.info/articles/analysis/data-portability-among-online-platforms.

[79] Aral, S. (2020). *The Hype Machine: how Social Media Disrupts Our Elections, Our Economy, and Our Health–and How We Must Adapt.* Currency.

[80] H.S.G. Pussewalage, V.A. Oleshchuk, An Anonymous delegatable attribute-based credential scheme for a collaborative E-health environment, ACM Trans. Int. Technol. 19 (3) (2019) 41:1-41:22, doi:10.1145/3338854.

[81] ACCESS Act of 2021 - H.R.3849 - 117th Congress (2021). https://www.congress.gov/bill/117th-congress/house-bill/3849/text.

[82] S. Schoenebeck, L. Blackwell, Reimagining social media governance: harm, accountability, and repair in a new light: social media governance reconsidered, Yale J. Law Technol. 23 (Special 1) (2020) 113–152.

[83] A. Jungherr, O. Posegga, J. An, Discursive power in contemporary media systems: a comparative framework, Int. J. Press Polit. 24 (4) (2019) 404–425, doi:10.1177/1940161219841543.

[84] F. Loecherbach, J. Moeller, D. Trilling, W.van. Atteveldt, The unified framework of media diversity: a systematic literature review, Digital Journalism 8 (5) (2020) 605–642, doi:10.1080/21670811.2020.1764374.