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Evolving in the Shadows: A Media Ecology Study of Dark Web Social Networks

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Abstract

This study conceptualizes dark web social networks (DWSNs) through the lens of media ecology theory. We synthesize existing literature to problematize a lack of understanding of DWSNs as a communicatively organizing system. The discussion then focuses on how DWSNs complement, compete, and hybridize with surface web social networks (SWSNs). This Interaction shapes DWSNs as communities of practice that both serve and evolve with the communicative and informational needs of their users. We introduce and elaborate two media-ecological concepts of DWSNs: (1) a medium that has become a message of antithesis to Web 2.0 and (2) an organism that has coevolved with SWSNs. An empirical indicator to explicate these two concepts is The Hub, one of the long-lasting DWSNs. The Hub serves as an example to juxtapose DWSNs with SWSNs, with a focus on their intermedia relationship, and characterize the symbiosis between DWSNs as hosts and their users as living organisms.

Keywords

dark web, media ecology, social networks, coevolution, anonymity

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The advancement of Internet technologies has bred distinct types of digital communities. Some of these communities dwell covertly on the dark web, which refers to a

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hidden network beyond the surface web not directly cataloged and indexed by search engines (Beshiri & Susuri, 2019; Faizan & Khan, 2019). Among the numerous services offered on the dark web, dark web social networks (DWSNs) offer users a communal space for anonymous information sharing and social interactions (Gehl, 2016). Dark web users are often depicted as asocial, antisocial, or stigmatized (Kaufmann & Tzanetakis, 2020). However, such negative ascriptions have dismissed the fact that many DWSNs are, in fact, "communities of practice" built on members' technical proficiency and purposive social activities (Kwon et al., 2020, p. 2738). Members need to attain some knowledge to use anonymizing technologies that buttress the technical infrastructure of dark web platforms (Kaufmann & Tzanetakis, 2020). To that end, DWSNs offer a communicative social space that helps members advance their agendas, which may range from criminal to political activism, through social interactions (Kwon et al., 2017; Kwon & Shakarian, 2018).

This conceptual essay delves into the nature of DWSNs by juxtaposing them with mainstream social networking sites accessible on the surface web. To achieve this goal, we examine these networks and their users through media ecology theory, which conceptualizes "media as environment," an ecosystem of symbols, techniques, and technology (Postman, 1970, p. 161, 1998; Strate, 2008). Studies that have examined the ecology of social networking sites on the surface web (such as Facebook) have sought to understand how users choose networking sites to meet their communicative goals (Putta et al., 2022; Zhao et al., 2016). Other studies have indicated that the pervasiveness of surface web social networks (SWSNs) in recent media ecosystems affects the cultural production of existing mass media, governance, media systems, and individual users' self-presentations (Arriagada & Ibáñez, 2020). These studies have informed media ecologists that the introduction of a communicative medium to the existing web environment affects users and alters their digital experiences.

Media ecology theory emphasizes the interdependency among media environments, human beings, and their interactions (Scolari, 2012). It maintains that new technology does not override an existing media environment but expands the taxonomy of possible intermedia relations. For instance, McLuhan (2003) suggested that various media coexist rather than cancel out or oppress each other. On the other hand, Postman (1970) proposed that media and communication technologies intrinsically affect human perception, feelings, and understanding. Both intellectuals have led to the establishment of media ecology as a subfield of media research that explores the relationship between media and their surrounding environments rather than the analysis of specific "content" that is produced and delivered in these environments (Arriagada & Ibáñez, 2020; Scolari, 2012; Strate, 2008).

The current study builds not only on the foundation of McLuhan and Postman but also on newer ecological schools of thought. Particularly, the works of Carlos Scolari (2012)[1] and Robert Logan (2007)[2] integrated biological metaphors into the discussion of media ecology and expanded the field to include terminologies such as evolution, coevolution, and coexistence. These scholars are the bedrock of

our inquiry to understand how the dark web—especially DSWNs—has gained traction in the post-web 2.0 era and how it negotiates its functionality with the mainstream "surface" web networks.

As a conceptual study, we explicate two media ecological characteristics of DWSN with the goal to argue the spillage and interdependence between the two web spheres (dark web and surface web): (1) as a message of antithesis to Web 2.0 and (2) as an organism that coevolves with the surface web. Our discussion is centered on DWSNs, a subset of dark web services that offer spaces for social interactions, not because DWSNs are the most important types of dark web services but because DWSNs epitomize users' lived experiences of the dark web as a communicative social space.

In the realm of dark web research, we observe a persistent trend where studies are centered on empirical discovery, often neglecting the ramifications from a communicative and social perspective. This focus is inherently rooted in the technical limitations that hinder broader inquiries in this field. To address these limitations, we propose an unconventional approach to interrogate existing studies on dark web research. Our approach involves critiquing these empirical discoveries through concept explication by introducing our media ecological model. This model serves as a benchmark to existing dark web phenomena to ensure that they are not merely observed but are elaborated through our claim and connected to a warrant (Reese, 2022).

Using Reese's (2022) framework as our building block, we begin the next section by identifying the problem—or a gap—in the current dark web research. For this, we summarize the current literature and create a new schematic for media scholars to advance the field of dark web research. The comprehensive literature review across disciplines in this section intends to demonstrate the dearth of understanding of the dark web as a communicative social space.

Following this section comes our main argument that introduces a media ecological framework to conceptualize DWSNs as a communicative space. In the process of conceptual manifestation (Reese, 2022), we introduce The Hub, one of the longest-standing DWSNs, as our "empirical indicator" (Reese, 2022, p. 8). Users of The Hub have extrinsic motivations to join the community and are willing to undergo effortful information processes of adopting anonymizing technologies that enable secure access to the network and other dark web services. We suggest that the motivations behind crossing into hidden domains are grounded in media-ecological factors that enable a new set of behaviors and attitudes. At the heart of the conceptual explication is the argument that DWSNs cannot exist or survive in isolation from the visible mainstream digital sphere, as reflected by ecological forces.

Statement of Problem and Literature Synthesis

The dark web research thus far has centered on technological architectural structures, such as network topologies (da Cunha et al., 2020), cryptography (Bancroft & Reid,

2017), interfaces, and database management (Benjamin et al., 2019). In this sense, the current dark web research trend resonates with the field of Software Studies, which has addressed a range of technical artifacts, such as affordances, network topologies, interfaces, machine languages, and lines of coding (Nieborg & Poell, 2018). That said, there is one noteworthy difference between the current dark web literature and the Software Studies of the surface web: While the latter has disentangled technical artifacts to formulate them as social forces underlying social relations, political actions, virtual life, organizational workings, and semiotics (Gehl, 2015a), dark web research has shown the cleavage between the architectural understanding and cultural sociological understanding.

Our systematic literature review has reaffirmed this gap. Specifically, we used the keywords "darkweb," "dark web," and "darknet" to search for articles across academic disciplines using the EBSCO Host, Academic Search Premier, Web of Science, and Communication and Mass Media Complete databases, from 2010 to 2022, the year of this writing. We chose 2010 as the starting point, considering that dark web technologies began to gain broader public attention at that time. We included articles identified in our review as long as they were about the dark web or darknet, peer-reviewed, and original research. Non-English articles, news reports, sponsored articles, letters, commentaries, feature magazine articles, and studies on marketing or advertising goals were excluded. In total, we reviewed 642 articles. To ensure high-quality reviews, we adopted the Critical Appraisal Skills Program to systematically assess the articles included in this literature review (Hill & Spittlehouse, 2001). The literature review identified three major prongs of current dark web research trends: *crawling and data mining, anonymous illicit economies, and ideological battlegrounds.*

Crawling and Data Mining

The vast majority of literature falls into this category, pointing to the difficulty of obtaining dark web data because of the encrypted or anonymized reconfiguration of the data streams. The awareness of restricted data accessibility (Hernández et al., 2019) has led to a considerable scientific effort in developing traffic analysis and indexing techniques to create custom directories or software to catalog dark web data (Alaidi et al., 2022). For example, in the absence of an Application Programming Interface, studies have reinvented traditional techniques such as web crawlers (Liu et al., 2020) or customized complex algorithms to identify hidden services and forums (Al-Nabki et al., 2019; Benjamin et al., 2019). Some studies incorporated cryptomarket analyses (Chawki, 2022; Kermitsis et al., 2021), detection of illegal activities and terrorism (Miller, 2020), examination of network structures (Graham & Pitman, 2020; Zamani et al., 2019), and topological analysis (da Cunha et al., 2020).

These studies have enriched technical know-how and toolkits to advance dark web analyses, yet the discussion has rarely pondered socio-technical implications of these research practices infiltrating dark web communities through technical and computational solutions they developed. Let alone ethical considerations, little discussion has been made

on how users of the dark web respond to the development of dark web crawling and mining techniques and practices, or how such development affects the sustainability and evolution of communities hosted in the dark web. In other words, this line of research has been inherently computational, technical, and tool development-centric, lacking the consideration of the consequences of these techniques on the evolution of communicative activities surrounding these communities.

Anonymous Illicit Economy

Another large chunk of dark web literature has been centered on illicit economic activities. The dark web has paved the way for establishing cryptomarkets on a large scale, allowing users to sell and purchase illegal items, including drugs, weapons, endangered animals, child pornography, sensitive information, and illicit services (Basheer, 2022; Moggridge & Montasari, 2022). Many of these markets mimic legitimate online retail platforms such as Amazon and eBay (Aldridge, 2019).

Martin (2014) defined a cryptomarket as an "online forum where goods and services are exchanged between parties who use digital encryption to conceal their identities" (p. 356). The technological infrastructure of cryptomarkets consists of several central components: cryptocurrencies (decentralized, unregulated, peer-to-peer digital cash systems such as Bitcoin), related transaction methods routing networks such as Tor, and message encryption services such as Pretty Good Privacy (Demant et al., 2018). These components work in tandem to ensure the security and anonymity of the users in an untraceable environment.

Rather than focusing on the underpinning ideology of cryptomarkets, most published research on cryptomarkets has focused on procedural aspects, such as the illegality of commerce (Martin et al., 2020), vendor characteristics, supply and demand relations (Bhaskar et al., 2019; Demant et al., 2018), market size and quality (Bancroft, 2022), and the difference between physical and digital transactions and purchasing experiences (Ouellet et al., 2022). These studies have offered insights into the dark web's illicit economy, but there is a lack of investigation on how these underground communities function as communities of practice that collectively build and share knowledge around goods and services circulating in the dark web. Thus far, criminological perspectives have dominated the discussion of the relationships between dark web markets, economic institutions, public policies, and the dark web (Benjamin et al., 2019; Martin et al., 2020).

Ideological Battleground

Some studies have examined cases of the dark web, which has unveiled ideological struggles and conflicts. The range of ideological expressions is broad. On the one hand, libertarian values have been underscored in terms of authoritarian oppression and free speech (Davis & Arrigo, 2021). Besenyő and Gulyas (2021) indicated that international journalists sought dark web forums to write stories about countries without laws that protected freedom of expression and free speech. Whistleblowing

has been shown to be essential for keeping democracy in check; however, it can be dangerous to expose governments, so some users seek DWSNs as an application for digital freedom to express legitimate concerns if not done through official diplomatic channels. On the other hand, institutionalism is centered on concerns about extreme speech or terrorism (Kaur & Randhawa, 2020). Studies on cyberterrorism have identified several ways in which terrorists can advance their agendas through DWSNs, including propaganda, psychological warfare, terrorist recruitment, fundraising, coordination, action, and data mining (Al-Nabki et al., 2019).

Hacking, also known as hacktivism, is another important concept in dark web research. As Chng et al. (2022) suggested, hackers exist across all moral spectra. While some hacktivist groups and institutional hackers—so-called "white hat" hackers—may have legitimate agendas, the motives of others—"gray hat" hackers—can be debatable.

These studies have made substantial contributions to the development of cyber policies on a global scale, yet the media ecological contexts in which these policies emerge have been largely overlooked. Undoubtedly, cyber movements have saturated both the surface and the dark web. The anonymity provided by these networks can provoke either toxic or benign disinhibition effects. Despite this, there is a noticeable gap in scholarly research when it comes to investigating the ecological reasons behind the proliferation of extreme cyber movements on the dark web.

Toward Understanding of Dark Web as Communicative Social Spaces

The review of the aforementioned three branches of research tracks (crawling/data mining, anonymous illicit economy, and ideological battleground) suggests that the current dark web research has largely missed out on a perspective that understands dark web communities as a communicative organizing system. Consequently, conceptualizing the dark web as a communicative space has been substantially marginal in the current dark web research literature, with only a handful of exceptions. For example, Weimann (2016) pointed out that anonymity is a conscious, strategic *social* act that conceals the source of a message from recipients and other spectators. Overall, the social-interactive consequences of anonymity have rarely been discussed in the dark web context.

The dark web literature's lukewarm interest in social-interactive aspects contrasts with the studies of conventional Computer-mediated Communication on the surface web, which have extensively examined how anonymity leads to social interactions, relationship building, and group dynamics (Masoni et al., 2016). Thus far, no dark web study has yet explained whether the anonymity afforded by the dark web has prompted users to engage in undesirable activities or whether users who intend to engage in such activities have been attracted to the dark web. This distinction is important because it has direct implications for content policy and regulation of webpages on the dark web. Instead, most dark web studies that discuss anonymity have focused on the technological requirements and conditions that enable users to maintain anonymity (Bancroft & Reid, 2017).

Gehl (e.g., 2015a, 2015b, 2016, 2018) is one of the few communication/media scholars who examined the dark web from a cultural communication perspective and described it as a hidden and alternative *social network* that defies surveillance, control, corporate hegemony, and mass media power. In his definitional work, Gehl (2015b) insightfully compared DWSNs and SWSNs, indicating that site governance, technical design, and anonymity are crucial elements that encourage or discourage users from joining a community. Although Gehl's work did not include media ecology theory, his studies paved the groundwork for this study's conceptualization of the dark web as a communicative space embedded in a larger media ecosystem.

Media Ecological Conceptualization of the Dark Web

Literature reviews suggest that there are gaps in the current dark web research when it comes to the human-centered understanding of the dark web. To fill the gap, it is necessary to conceptualize the dark web as a communicative organizing system that is situated in a larger web ecosystem. This paper posits that the media ecological framework helps fill this gap.

Postman (1970; p. 161) famously defined media ecology as the "study of media as environment." Media ecology theory-based research has addressed how introducing a new medium serves as an ecological force by simply adding something (Postman, 1970). The media ecology framework helps to conceptualize the dark web as a part of web environments that coexist and coevolve with the surface web. McLuhan (2003) illustrated this point:

> (Media ecology) means arranging various media to help each other so they won't cancel each other out, to buttress one medium with another. You might say, for example, that radio is a bigger help to literacy than television, but television might be a very wonderful aid to teaching languages…if you watch the whole field, you can prevent this waste that comes by one canceling the other out. (p. 271)

The dark web allows users to navigate, advocate, and participate in activities that are constrained by surface web environments. Paradoxically, the thriving of the dark web is contingent on what the surface web affords or constrains. For example, the corporatization of media systems, government regulations over digitized institutional practices, and privacy exploitations on the surface web have motivated the cultivation of the dark web as a digital space that is free from power and control. In other words, a broader media ecological lens is necessary to gain a more comprehensive view of the sustenance and evolution of the dark web and the promotion of new set of user behaviors and attitudes within it.

Similarly, McLuhan and McLuhan's (1988) notion of Laws of Media (LOM) underscores the need for an ecological understanding of the technological conditions of the dark web. The LOM emphasizes how a new media artifact enhances human functions

by repurposing an older artifact, rendering it obsolete, and "when pushed far enough, flip[ping it] into a new artifact that is it is complementary" (Iseri & Logan, 2016, p. 153). For example, while dark web research has predominantly focused on the development of web crawling and data mining, these developments are essentially reinventions of old web crawling techniques for the first-generation Internet. Furthermore, dark web users have customized the technology to circumvent crawling software (Benjamin et al., 2019). Likewise, illicit markets in the dark web facilitate the peer-to-peer trade of services and goods, with added features that mimic surface web markets such as Amazon and eBay. The online review systems developed in surface web markets have spilt over into the workings of dark web markets but are flipped into the most vital trust mechanism when coupled with alternative finance transaction methods (e.g., escrows and cryptocurrency transactions). With the premise of the media ecological framework, we expand the conceptualization of the dark web (i.e., DWSNs) as a communicative social space by focusing on two ecological dimensions.

DWSNs as a Message of Antithesis

Antithesis to Corporatized Web 20. The term "antithetical" or "antithesis" originated from Greek as a stylistic pair figure. This terminology is based on the parallelism of relative terms (e.g., angels vs. devils; black vs. white; freedom vs., oppression; Ruzibaeva & Mirgiyazova, 2021). This also means that two opposing objects are inextricably intertwined, thus creating concepts in a relationship of contrast. Even concepts that have not been connected by any relationship become a conflict once drawn together to this parallelism.

To conceptualize DWSNs as antithetical social spaces, we resort to McLuhans's (2003) work, which broadened the definitions of "medium" and "technology" as means to extend or hinder human beings and their capabilities. Media and technology can enhance, numb, or amputate human language and experiences. To succinctly describe this nature, McLuhan (2003; p. 17) introduced his famous axiom, "the medium is the message." In the context of the dark web, McLuhan's axiom suggests that the use of a DWSN itself as a medium signifies ideological expressions that are antithetical to those upholding the "Web 2.0" culture of the surface web. For example, Facebook and Google are dominant corporations on the surface web; their users ultimately serve these corporations' interests by commodifying users' behavioral data and personal information (Gillespie, 2018). However, DWSNs explicitly reject this commercial interest by adhering to pre-Web 2.0 technical designs that are optimal for prohibiting access to personal traces of digital activities. That is, the abhorrence of the "corporate Internet" is overt (Gehl, 2015b).

Importantly, a DWSN's outright exclusion of personalization from its interface designs is not due to technical incapability but from site users' expectations, needs, and desires. That is, the technological conditions of the website correspond to community members' consensus that large institutions are antithetical to their dark web community. The interplay between the site's interface design and its users' shared mentality

illustrates that the interface itself is a message by "modeling [users'] perception and cognition" (Scolari, 2012, p. 209).

In fact, the rise of DWSNs as antithetical social networks is reminiscent of the so-called "Web 2.0" movement in the surface web in the mid-2000s. This movement became a direct challenge to the monolithic media industry. Web 2.0 triggered an evolution to liberate control over mass media, and pioneers' grip over the mass media industry eventually waned (Gillespie, 2018). Scolari (2013) discussed this circumstance concerning the lifecycle of media, which includes emergence, dominance, and survival or extinction. During the emergence of television, radio, and print press, mass media pioneers were able to impose a set of rules on their consumers. The pioneers were forced to adapt to changes with the rise of new media actors, such as SWSNs, during the Web 2.0 era. Their existence is contingent on their visibility in new media to survive extinction (Scolari, 2012).

Ostensibly, the premise of Web 2.0—especially SWSNs—was to decentralize the media industry by shaping a user-centered media culture (Gehl, 2015a; O'Reilly, 2012). However, Nieborg and Poell (2018) noted a paradox in the industry of Web 2.0: While SWSNs like Facebook and Twitter have challenged traditional mass media powers, SWSNs have now emerged as new oligarchical corporate players—perhaps even more influential than traditional mass media. Their end goal is not to emancipate users from a monolithic media market system but to monetize the participatory culture by tracking users to predict consumer behavior.

Antithesis to the Culture of Self-Disclosure. One of the most widely shared norms in Web 2.0 and mainstream SWSNs is perhaps the culture of self-disclosure. Users increasingly create social profiles that reflect or amplify their real-world self-identity to build trust and authenticity through the visual and discursive presentation of the self. Visual presentation refers to the extent to which people can see and hear a message sender; whereas, discursive presentation occurs when specific textual cues can be attributed to an identifiable individual (Gilpin et al., 2010). Although there are no written rules that mandate real identities in SWSNs (Gehl, 2015a), the consensus is that a real identity-based profile incentivizes users to build a reputation and answer the question "who am I?," and establish and maintain interpersonal connections (Ellison et al., 2012). Furthermore, the culture of self-disclosure is coupled with the context-collapsing design that flattens multiple distinct audiences into one indistinguishable group, making self-promotion more convenient and far-reaching. Although effective in broadcasting messages, context collapse blurred the boundaries of privacy, and became a challenge to maintain a distinct presentation of self for different audiences (Brandtzaeg & Lüders, 2018).

DWSNs are in stark contrast to the culture of self-disclosure because anonymizing technologies and norms, which hide one's identity, are crucial for the survival of dark web services. Anonymity is an affordance that affects online users' behavior, particularly how individuals present themselves to others and how they might feel more disinhibited (Suler, 2004). According to the media ecology view, media organisms protect

themselves from being "infected" by hostile competitors through the activities of organisms and nonorganic matter surrounding them (Logan, 2007; Scolari, 2012). This view permits positioning anonymity-granting infrastructure as a nonorganic entity and anonymity-championing culture as an organic measure to protect DWSNs.

Specifically, anonymizing technologies, such as the Tails operating system or Tor browsers, provide an infrastructural environment that conceals user identity. Although users on the surface web may use a virtual private network (VPN) to enhance secure access, the use of a VPN on the surface web does not guarantee anonymity because most major VPN companies can track and store IP addresses. Furthermore, using mobile phones as a means of communicating with other users on the dark web is discouraged. Mobile encryption services (including Tor and VPNs) provide privacy protection against intrusions, and mobile phone devices can collect the stored data within the device, which can then be exploited by corporate and government agencies (Jiang et al., 2022). Furthermore, most dark web services *mandate* a culture of self-hiding by enforcing alternate identities and zero tolerance for exposing real identities. Accordingly, it is ill-advised to create a profile in the same manner as one would create on the surface web. A profile with a clear visual and discursive self-presentation defeats the fundamental purpose of using a dark web. Anonymity rules are enforced both communicatively (e.g., through criticizing norm-violating behaviors) and technically (e.g., by deleting a post or member's account). As Gehl (2016; p. 1225) states, the "aggressive mapping of real-world identities is part of the problem that dark web social networks seek to address."

Coevolution Between Two Web Spheres

As a central concept of media ecology theory, an intermedia relationship addresses how different media synergize content production, narratives, aesthetics, and other media components (Scolari, 2012). Contemporary media ecology theorists such as Logan (2007) noted that "media ecology has focused on the environment in which media operate without exploring at a deep level the implications of the biological nature of ecology" (Logan, 2007, p.1) and proposed to study intermedia *coevolution* through which "media and technologies like languages and cultures evolve in a manner very similar to that of biotic organisms" (p.12). The intermedia coevolutionary view borrows Rothschild's (1962) biosemiotics metaphor, which indicates that in the biological domain of parasitism, coevolution between the host and living organisms (e.g., parasites) occurs by establishing cooperative and/or predatory behaviors. Biological evolution models have been adopted to examine technological development in various contexts (Arthur, 2009; Frenken, 2006; Logan, 2007).

In the biological realm, ecosystems consist of hosts and living organisms that inhabit them (Logan, 2007). These ecosystems are also composed of infrastructure, languages, specific norms, and codes of conduct that allow users to develop communicative habits. Building on Logan's biological view of media and technology, we can view DWSNs as host networks and their users as living organisms.

As living organisms, dark web users have the ability to mutate and coevolve not only within their host network but also by exploring other networks in the larger media ecosystem, which is composed of other dark web sites, surface web services such as SWSNs, mainstream media outlets, mobile apps, and messaging services. As Scolari (2012; p. 215) posits, "if every text constructs its own reader and every interface constructs its own user, then every media constructs its own consumer." This view resonates with Zhao et al. 's (2016) suggestion that the availability of different media networks creates and diversifies users' needs; thus, having one's communicative needs met entirely by a single media network would be rare. As motivation evolves, users may adopt new behaviors and develop a new culture, through which new user typologies emerge within the network. That is, "mutation" occurs between users (living organisms) and the network (host).

Mutations may not occur for all users and may not lead to the evolution of the host medium. Users can abandon the host medium even before becoming part of their community. Some users may not follow a linear process of becoming a part of the community, whereas others may discard their roles in the community and revert to their roles in previous communities (Zhao et al., 2016). A user's choice to join or abandon a host medium does not rely solely on the relationship between the user and host. The choice is made within a larger intermedia ecosystem.

Alternatively, some users may choose to hybridize between different media instead of outright abandoning one. Hybridization is an important coevolutionary process that involves interactions and the contamination of various media (Scolari, 2012). McLuhan echoed this process on several occasions by calling it the "interpenetration of one medium by another" (McLuhan, 2003, p. 76) or "cross-fertilization" between media (McLuhan, 2003, pp. 58–59). The hybridization of two media releases "great new force and energy as by fission or fusion" and at the time same time promotes a "new form" of a communication medium (McLuhan, 2003, pp. 72–80). That is, the dark and surface web can hybridize by developing and establishing cooperative or predatory relationships.

An Empirical Indicator of Media Ecological Understanding of DWSNs: The Hub

The development of anonymizing technologies began in the late 2000s, laying the technical groundwork for a dark web culture in response to the increasingly intrusive Web 2.0. For example, the development of the Tor browser began in 2008, soon after the Web 2.0 culture became mainstream (Davis & Arrigo, 2021); the security-focused Tails operating system was first released in 2009, and Bitcoin, the first cryptocurrency, was also released in 2009 (Dawson & Cárdenas-Haro, 2017).

Although The Hub—the empirical indicator of this article—was launched in 2014 and did not exist in the earliest period of the dark web, it is one of the earliest and longest-surviving DWSNs. The Hub has served as a place for users to further their

knowledge about cryptomarket commerce, which also began burgeoning in the late 2000s and the early 2010s. Although other dark web researchers have examined The Hub in the past, studies have predominantly focused on criminal typologies and techniques to detect malicious activity signals (Al-Nabki et al., 2019; da Cunha et al., 2020; Davis & Arrigo, 2021; Finklea, 2017). Existing literature has overlooked the social and communicative aspects of The Hub.

We adopted a fieldwork approach by registering and observing The Hub's user community. We accessed the site by using the Tails operating system, a "portable operating system" that "never writes anything to the hard disk and only runs from the memory of the computer" (tails.net). Registration on The Hub required a dark web-hosted email address and completion of CAPTCHA tests. After completing registration, we received "provisional" approval to join the community until we finished the "initiation process," which involved making 20 posts in the newcomer section and demonstrating technical knowledge. After making the initiation posts, we minimized our posting activities and primarily remained as lurkers. We surveyed The Hub's site design, community charter, and user typology to explicate ecological concepts. While numerous exemplars exist on The Hub, we selectively chose and reported a few exemplary posts that we deemed to be the most illustrative of antithetical and coevolution concepts.

Antithesis to Web 2.0 Culture

As an (illicit) commerce-oriented community, The Hub's architecture resists mainstream commercial interests. Allowing commercial forces to intervene in The Hub's governance would compromise the community's independence from the privacy-intrusive digital economy. Accepting paid services and sponsored content requires consistent monitoring of site activities and trading users' attention to monetary gain. The Hub's refusal to participate in the mainstream digital economy echoes Gehl's observation that some DWSNs have refused to extend privileges to "moneyed speech" (Gehl, 2015a). Moneyed speech refers to the idea that those with the most financial resources are entitled to speak the loudest, be prioritized, and are the most prominent in social networks.

Besides moneyed speech, The Hub also rejected context-collapsing interface design (Brandtzaeg & Lüders, 2018). In contrast to collapsing contexts, The Hub has compartmentalized its interface to maintain a distinct line of information to separate the message's purpose from an unintended audience. This design feature is important because it allows community members to fulfill their own needs for interest-based interactions with minimal interruptions by irrelevant messages while respecting the needs of community peers with different "contexts" of interest, knowledge, and information.

Further, The Hub's community administrator explicitly states the importance of anonymity for the community and some of the practices that could deanonymize the user (see Figure 1). In contrast to SWSNs, the burst of behaviors and attitudes that exist in The Hub involves removing cues of users who practice alternative self-presentation

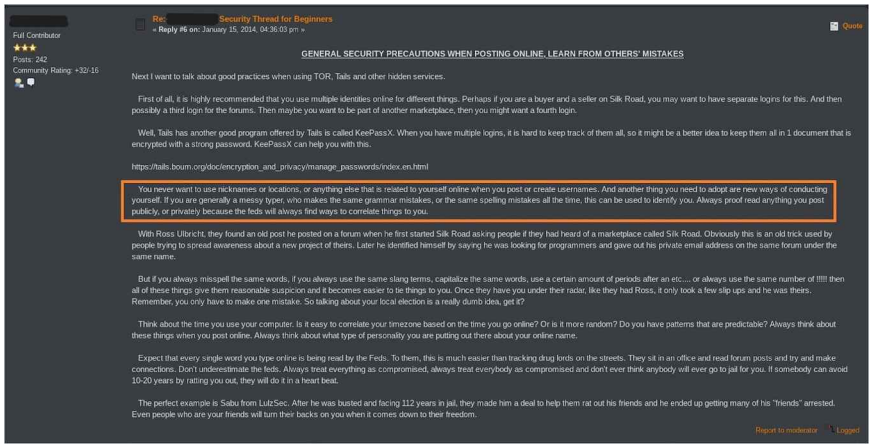

Figure 1. Screenshot from The Hub about rules and regulations. The comment in the orange box demonstrates the importance of alternative self-revelation.

that cannot be linked to one's true self. Accordingly, creating pseudonym identities and an alternative self-presentation that disguises their true self is essential to prevent a user from being tracked. Furthermore, anonymity has a significant cognitive impact on communities. This eliminates any perceived perceptions of ingroup members. The Hub's guideline for anonymous self-presentation is meant to protect individuals who wish to remain unidentified and collectively protect community members.

In summary, by designing an interface that is antithetical to the logic of Web 2.0, The Hub, as a medium, becomes a message of the political economy that opposes the consolidation of media ownership, Web 2.0, consumerism, corporate capitalism, and self-disclosure culture.

Coevolution With Surface Web

It is not unusual for users to traverse both the dark web and the surface web. The "cross-sphere" coevolution both drives and is driven by user motivations and activities (Zhao et al., 2016). Users often visit or join The Hub through a surface web search. For instance, Reddit is a popular SWSN known for its pseudonymous culture and slack approach to content moderation. It is accessible on the surface web via conventional browsing technologies such as Safari, Google Chrome, and Firefox (Kwon & Shao, 2021). Reddit unwittingly established cooperative relations with The Hub by allowing discussions of dark web-related knowledge. Reddit is located in both web spheres, meaning that dark web users can conveniently log into Reddit to interact with potential newcomers without switching their browsers. Consequently, Reddit users can gather information, broaden their worldviews, and learn to join a hidden DWSN community from experienced dark web users. In this case, Reddit and DWSNs have a cooperative

intermedia relationship, which creates a pipeline to sustain the existence of dark web communities.

Meanwhile, a predatory relationship also exists between The Hub and other media. For example, Gehl (2016) noted that Google once attempted to index DWSNs to enable surface web users to obtain a sense of dark web activity without actually being a member of the DWSNs. Making DWSNs visible through a Google search index allows users on the surface web to discover DWSNs. Users of The Hub regard Google indexing as a predatory practice that compromises their privacy and security. For example, in The Hub, a member known as EternalBlite alerted other members about surface web-based institutions "policing the darknet" and called for their "own federation" to fight intrusion from outsiders (see Figure 2). This exertive call from the user exemplifies a predatory reaction to alert foreign intrusion into the host network (Logan, 2007). In other words, The Hub users consider certain surface web activities as foreign parasites attempting to infect the host network.

As part of the defense mechanism within the host network, The Hub's moderators stress to their community members that they should not hyperlink URLs originating from the surface web, implying that it is a risky sociotechnical behavior on DWSNs because governments and corporations can sophisticatedly prey on the community by tracking hyperlinks to identify the user. Instead, The Hub encourages its users to "leach" surface web media by directly copying and pasting the content of interest or writing a post about it. Additionally, when it is necessary to hyperlink a surface web URL, users must place a warning note indicating that the linked URL originated from the surface web. This practice has been essential in The Hub to prevent possible "media infection" by governments and corporate agencies (Al-khateeb & Agarwal, 2015).

The Hub's relationship with legacy news outlets is both predatory and cooperative. On the one hand, The Hub members were wary of journalists infiltrating the dark web and maintained an overall aversive attitude toward the news institutions and their attempt to investigate their community. On the other hand, The Hub members have referred to mainstream news coverage as a trustworthy barometer for their sensemaking during an unstable period of the dark web. For example, in normal times, illicit market users in The Hub exchange market information retrieved from news sites or content aggregator pages hosted on the dark web. However, members actively monitor mainstream news reports when the market conditions are highly uncertain, such as when they are shut down. Figure 3 illustrates the media ecosystem of The Hub.

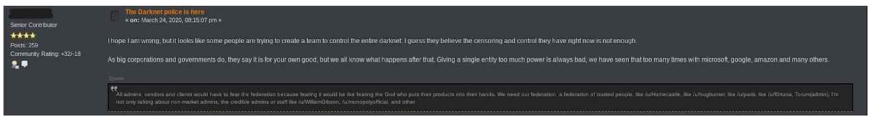

Figure 2. A discussion thread in the Hub about the predatory nature of surface web institutions.

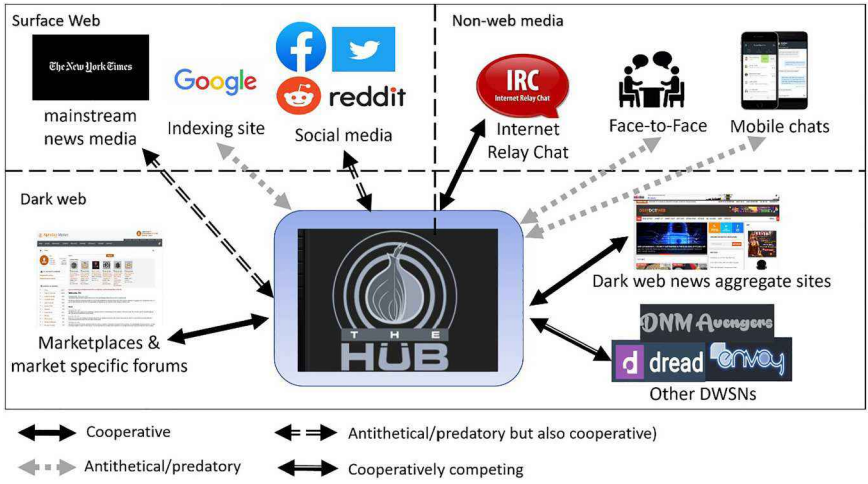

Figure 3. An example of the media ecosystem surrounding The Hub.

Discussion and Conclusion

This study began with a literature review of dark web research to highlight the limited understanding of the dark web as a communicative organizing system. We address this gap by introducing the media ecological conceptualization of the dark web, with a particular focus on DWSNs. While media ecology is not meant for conventional, linear empirical research (Strate, 2008), it helps conceptualize the cultural, social, and psychological conditions under which media practices are bred. Media ecology scholars contend that media serves as a message, extends human communicative functions, and coevolves with other media in a larger ecosystem. This study intends to show how these features of media also apply to the dark web, extending the literature beyond its current technological and criminological focus to address the ecological dynamics of the dark web. Specifically, we elaborate on two media ecological features of DWSNs: (a) as a message of antithesis to Web 2.0 and (b) as an organism that coevolves with the surface web. To manifest these conceptual propositions, we used The Hub as an empirical indicator.

The dark web is a network of services designed to be an anticorporate internet. Users join these hidden networks as part of a community that refuses to abide by government and corporate institutions' technical, economic, and speech regulations. Although Tor and other anonymizing technologies are essential for hidden communities, the communicative norm of anonymous self-presentation is equally important in the dark web, including DWSNs. Anonymity as a communicative norm of the dark web is an essential requirement for community member status—contrasts with the increasing promotion of real identity-based social interactions in SWSNs.

DWSNs and SWSNs exist in two separate web spheres; however, they influence each other by establishing predatory and cooperative links. Some surface web users

who traverse DWSNs may not be prepared to engage in anonymous self-presentation and risk exposing themselves to predatory behaviors such as blackmail, hacking, and identity theft. However, some SWSNs, such as Reddit, offer a channel for surface web users to hear about the lived experiences of seasoned dark web users, thereby facilitating the hybridization of the two web spheres.

To summarize, DWSNs do not exist in isolation but rather coevolve with the mainstream culture on the surface web. To this end, we argue that DWSNs are countercultural products of corporatized Web 2.0 while also being interdependent on SWSNs for their own evolution (e.g., an influx of new members). To the best of our knowledge, this study is the first to conceptualize the ecological relationship between the dark web and the surface web. That said, this study represents only a first step in this direction and has not fully incorporated every subdomain of dark web services. While this study broadly discusses the ecological view on DWSNs, future research can leverage this discourse to delve deeper into the ecosystems of terrorism, cyber warfare, or whistleblowing in DWSNs.

While this article was a conceptual study, future research can build upon our conceptual work to examine communicative and media ecological dynamics of the dark web from an empirical research approach. One promising empirical research agenda that extends our ecological conceptualization may be to investigate how and to what extent novice users join DWSNs (or other dark web services) through SWSNs. Additionally, future research could examine beyond novice users to understand what types of surface web services regular dark web users rely on to complement their communicative or informational needs. These types of questions can be addressed by empirical data and analytics, such as content analysis of SWSNs (e.g., subreddits on Reddit) to identify and categorize Q and A initiated by a new user's post to understand specific types of assistance they receive from experienced users. Also, hyperlink analysis across multiple DWSNs may uncover the proportion between information sourcing from within the dark web and that from the surface web. Our ecological conceptual work may pave the ground on which these kinds of empirical questions and methodological approaches emerge to offer important insights for human-centered dark web governance. Continuing ecological discussions can benefit media scholars, cybersecurity analysts, and policymakers by understanding how media systems manifest and sustain hidden organizing systems.

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Notes

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2. Robert K. Logan taught at the University of Toronto, in addition to math-based physic courses he taught interdisciplinary course—the poetry of physics, which led to his collaboration with Marshal McLuhan, and his research in media ecology and the evolution of language.

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